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FROM THIS ROOMVOLUME 8 NUMBER 3
FEBRUARY 14, 1989

The Truth Behind the Hype: PC Labs Tests Nine 25-MHz 386 Machines

- Boost System Performance
with 13 Low-Cost
Disk-Caching Utilities
- Better Tools for Graphics:
 - 17 Mice
 - Challenge Microsoft
 - 11 8514 Monitors
 - Surpass VGA
- PC Lab Notes:
CADD Smart
for the Layman



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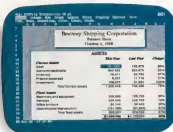
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				~4.97
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SM-141	Smoked Duck			
SM-151	Verison Loam			
SM-161	Sausisson			
SM-171	Blood Sausage			
Sauces				
SA-111	Hollandaise			
SA-121	Bearnaise			
SA-131	Boeufaise			
SA-141	Carolina Barben			
SA-151	Texas Barben			
SA-161	Cumberland			
SA-171	Aioli			
SA-181	Pesto			
SA-191	Carbonara			
Condiments				
C-111	Japanese			
C-121	Maitre			
C-131	Onion			
C-141	Pesto			
C-151	Philly			
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C-171	Philly			
C-181	Philly			
C-191	Philly			
C-201	Philly			
C-211	Philly			

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The Atlantic Group of Mutual Funds Stock Funds - October, 1988

Total Return	Capital Growth		Diversification and Growth	
	ATLANTIC FUND	ATLANTIC FUND	ATLANTIC FUND	ATLANTIC FUND
1 Year (12/31/87)	12.0%	18.4%	12.0%	18.4%
3 Years to Date	12.0%	18.4%	12.0%	18.4%
10 Years to Date	12.0%	18.4%	12.0%	18.4%
Net Asset Value: 10/1/88	12.0%	18.4%	12.0%	18.4%
Dividends				
1988 Income	12.0%	18.4%	12.0%	18.4%
1988 Capital Gain	12.0%	18.4%	12.0%	18.4%
1987 Income	12.0%	18.4%	12.0%	18.4%
1987 Capital Gain	12.0%	18.4%	12.0%	18.4%
# Months Dividend Paid	12.0%	18.4%	12.0%	18.4%
# Months Cap Gain Paid	12.0%	18.4%	12.0%	18.4%
Fund Facts				
Quarter Symbol	12	12	12	12
Fiscal Year End	12	12	12	12
Current Proprietary Date	12	12	12	12
Assets (10/31)	12	12	12	12
Shareholders	12	12	12	12
Min Initial Investment	12	12	12	12
Min Subsequent Investment	12	12	12	12
Letter of Intent	12	12	12	12
Right of Accretion	12	12	12	12
Exchange Privilege at NAV	12	12	12	12

Corporation

Sheet
1988

This Year	Last Year	Change
247,886	126,473	121,413
993,862	53,870	939,992
79,271	11,716	67,555
9,267	31,834	(22,567)
108,877	748,488	(639,611)
1,308,443		

This Year	Last Year	Change
209,906	168,790	41,116
478,505	243,793	234,712
10,240	38,404	(28,164)
(101,090)	(84,384)	(16,706)
648,333	374,330	274,003
\$1,896,898	\$1,123,020	\$773,878

AND SHAREHOLDERS' EQUITY

This Year	Last Year	Change
426,041	332,843	93,198
46,327	23,498	22,829
34,614	26,020	8,594
85,845	81,540	4,305
954,627	434,197	520,430

This Year	Last Year	Change
488,832	348,243	140,589
147,844	92,151	55,693
636,648	440,394	196,254

This Year	Last Year	Change
1,000	82,631	(81,631)
248,468	163,836	84,632
418,794	247,415	171,379
685,706	411,246	274,460
\$1,123,020	\$1,123,020	\$0

This is about

At this moment, millions of Lotus® 1-2-3® users are faithfully awaiting the arrival of a product called Release 3. A character-based product that promises greater power



Microsoft Excel. Or, how to see Lotus 1-2-3 Release 3 from a whole new perspective.

and greater productivity for serious spreadsheet users.

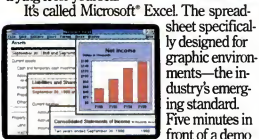
As soon as it gets here.

In the meantime, we have a question:

If Release 3 is in fact character-based, and the entire personal

computing industry continues moving toward *graphics*-based environments, is it wise to wait for Release 3? Or consider the alternative.

Actually, you can do both. Because you have nothing to lose by seeing the other side of the spreadsheet story, and trying it for yourself.



Unfortunately, 1-2-3 won't let you move, size, and link an unlimited number of files at the same time. Fortunately, Microsoft Excel will.



As you know, with 1-2-3 your ability to customize worksheets and charts is limited. As you may not know, with Microsoft Excel the possibilities are limitless.



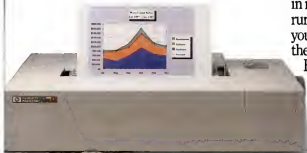
easiest, most enjoyable way to crunch your numbers. Thanks to an incredibly intuitive design that exploits innovations like Micro-

soft Windows, OS/2 Presentation Manager and, of course, the Macintosh®.

You're a loyal Lotus user. If you're a bit skeptical, we fully understand that. We also anticipated it. So we've made sure your hard-earned equity in 1-2-3 is not

obsolete. In fact, we've not only made a transition to Microsoft Excel attractive, we've also made it easy: Microsoft Excel actually reads and writes

t Lotus 1-2-3.



No more wasted trips to the printer. Microsoft Excel comes with Print Preview for true WYSIWYG. Unlike Release 3.

1-2-3 files and even helps translate macros. It also offers the convenience of 1-2-3 on-line help—so you can expect a surprisingly smooth transition. In fact, the slash key you punch to access your 1-2-3 commands is the same key that can access Microsoft Excel commands—you don't have to relearn a thing.

Another issue: hardware.

As Lotus may or may not have told you, Release 3 will need a substantial investment in new hardware. The same hardware that runs Microsoft Excel. All we're saying is, if you're committing to new machines, make the most of those new machines. Something Release 3 simply won't.

But, using is believing. So we've made it convenient to get a sample of Microsoft Excel in your hands. Simply call us at (800) 541-1261, Dept. J14 for a free sample disk of your own. It's worth the call. It's worth the experience.

In fact, we're so confident about Microsoft Excel that we're offering a no-questions-asked, money-back guarantee good through January 1990. Which means we're actually willing to guarantee our current technology against Lotus technology that isn't even available yet.

All of which brings us to a decision millions of you are about to face:

Upgrade to character-based Release 3, or upgrade to the power and simplicity of a graphics-based spreadsheet. We're not saying it's an easy decision.

Just an inevitable one.

Microsoft
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For even more convincing, call for a sample disk. The disk is free. But the experience is priceless.

Yes, graphics-based Microsoft Excel was designed around a mouse. You can also use it without one.



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VOLUME 8 NUMBER 3

WHAT'S INSIDE

How do the tools we use change both the way we work and how we think about the work we do? How do they change the nature of the work itself? And is faster always better—or even desirable? Fodder for the intellectual pleasure of debate that academics and writers thrive on? Certainly, but more than conversation topics for the classroom or the café, these questions relate directly to the practical decisions all PC users have to make. And they are especially timely, since faster and more-powerful computers, like the nine 25-MHz 386 machines reviewed by Alfred Poor in this issue's cover story, are increasingly within our grasp.

As much as a now-out-of-date 8-MHz AT used to frame our relationship to our work, shaping our behavior to match its clock speed, so will this new breed of PCs. Time was when a user could believe that he was also serving while he sat and waited for an 8088 or 286 to crank through a complex recalc or compile—or that he could do some useful work away from the keyboard. That time isn't now. "The PC that's going to help me the most," says Poor, "is the one that I'm not aware of, that doesn't get between me and my job, that creates fewer wait states in me." If by necessity a tool must intrude between its user and the job he is trying to do, then using the tool minus its intrusiveness should amount to a net gain. Using the fastest PC maximizes the net.



Operating at zero wait states: frequent contributor Alfred Poor.

Each new round of fleet-footed PCs encourages us to want to work faster and, at the very least, gives us the impression that we are. But it's not long before an advertisement for a new, more-powerful machine convinces us that the current speed king is moribund—and so is our productivity. Case in point: at least one manufacturer has already stated that a 33-MHz PC, the next in the sibling order after the 25-MHz machine, is not far down the road. What next?

For the most part, PC users want to own state-of-the-art equipment so that they can speed up labor-intensive workaday operations that dull the senses and the spirit. Beyond that, purchasing the fastest machine is one way to become a participant in the technological revolution that is constantly being played out around us. But, of course, the state of the art is only a temporary condition: there is never a "fastest" in the computer industry for very long.

—Robbin Juris

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New forms of expression The speed and power of JetScript combine to give your LaserJet Series II a form of expression that's found only with PostScript.

Simply, PostScript opens up the full range of possibilities for desktop publishing. You have complete control over the final look of the page, down to the last exacting detail. PostScript allows for an infinite number of font variations and sizes. That makes PostScript's limitless flexibility and power the perfect complement to your LaserJet Series II, giving you the high-quality output you require.

Impressive results People have come to expect impressive results from QMS—one of the first companies to bring the power of PostScript to laser printing, and now with more PostScript-based products than any other company.

You'll get the same results from the new JetScript. After all, it has HP's blessing.

Laser Connection is a sales and marketing subsidiary of QMS. Call **1-800-523-2696** for the location of your nearest Laser Connection dealer.

JetScript available for IBM PC-XT, IBM PC-AT*, HP Vectra™ and compatible personal computers, or the IBM PS/2™ Model 30.

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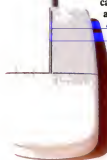
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PC MAGAZINE

COVER STORY



25-MHz 386s: Fast, Expensive, and Worth It
Alfred Poor PC Magazine's first roundup of 25-MHz 386 machines includes nine of the fastest PCs money can buy. If you need to include software development, or use of a CAD or desktop publishing program that incorporates a lot of graphics, or if you want to use a 386 as a LAN file server, our in-depth reviews, features table, and benchmark tests will show you the machine that could revolutionize your working world..... 94
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The latest and greatest in state-of-the-art mouse technology begins on page 249.

**ALR FlexCache
25386DT**

Cover Photograph:
Thom O'Connor

**IBM
Model 7**

\$9

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SOFTWARE Getting the Most Out of Memory

Edward Mendelson

Significantly reduce your time spent at the computer by speeding up all operations that access information on disk—hard or floppy. Check out our in-depth reviews, features table, and benchmark tests to find the software that can greatly accelerate your access to frequently used data..... 157
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Applying the Standard: Programming Applications for 8514

Charles Petzold The 8514/A adapter card poses programming challenges unlike those presented by other video display adapters. Here, a master programmer discusses issues you'll face when writing 8514/A applications..... 233

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Tracking the Mouse's Progress

Tom Stanton Whether you're an engineer, an artist, or a businessperson, graphical user interfaces are moving into your workplace—and with them, mice. PC Labs evaluates 17 mice that could redefine the way you work..... 249
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Hertz 386/25

"Built on a motherboard and case package from Intel, the Hertz 386/25 uses quality components and solid construction backed by an on-site warranty, but its price makes it a less attractive value than some of the alternatives."

FIRST LOOKS

Hands On:

- *Ami: Samna's \$200 Microsoft Windows-based word processor*
- *Perspective Junior: a lively, streamlined reincarnation of Boeing Graph*
- *Grammatik III and RightWriter 3.0, head-to-head*
- *Computer Database Plus searches articles from 48 computer-related publications*
- *Turbo EMS expanded memory manager*
- *Mechanical Engineering Workbench: An engineers' dream*
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IF ANYONE TELLS YOU THEIR MOUSE OUTPERFORMS MITSUBISHI'S, THEY'RE SLIPPING YOU A MICKEY



We proudly present three reasons why Mitsubishi will soon be the mouse you'll see scampering across more and more desktops: **M-Mouse, E-Mouse and S-Mouse.**

These fast-moving, versatile mice are now showing up in every field in America. And with good reason. Because Mitsubishi understands the importance of building a mouse that meets the user's standards of speed, comfort and reliability across a range of DPI requirements. And with that in mind, we built three mice designed to provide you with performance that you can rely on time and time again.

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Ask any computer expert about what type of system you should buy nowadays and you'll likely get a "pass the bus" response. Something like — "Well, uh, the PC/AT* bus is your best buy but, then again, the new PS/2* bus may become the next industry standard." Great advice, right? If trying to decide on a microprocessor weren't tough enough, now you're expected to pick a bus, too.

RELAX, NOW THERE'S COMPUSTAR!

The all new CompuStar from Wells American not only lets you interchange microprocessors, you can also mix and match buses — a PC/AT bus, a PS/2 bus or... both. As your computing needs change, simply snap in a new processor or add an extra bus. You'll never again have to worry about buying the wrong computer system!

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A CONVERTIBLE BUS? YOU'RE KIDDING!

No, we're not. In fact, it may well be the most practical microcomputer innovation ever. Say you've selected an AT compatible CompuStar and later want to add PS/2 compatibility. No problem! Snap in a PS/2 Bus and Adapter Module and you can use both buses in the same system. Likewise, if you've selected a PS/2 compatible CompuStar and decide you want to add an AT bus, just snap in an AT Bus Module. Depending on configuration, the CompuStar can have up to 13 bus expansion slots — all AT slots, all PS/2 slots or a "split-bus" of AT and PS/2 slots. No matter which bus becomes the next industry "standard," you'll have peace of mind knowing your investment in a CompuStar will be protected.



The CompuStar is also easily expanded. That's because there are seven CompuStar disk/tape compartments — six accessible from the front and an additional full-height bay inside. All this in a sleek, compact tower design that will leave more room on your desktop than any of the so-called "desktop" models.

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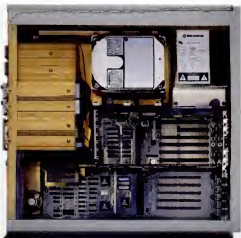
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front panel and literally "snap-in" a bus, CPU, memory or disk module in a matter of seconds. It's system flexibility never before available... at any price.

While one of our competitors (we won't mention any names) threatens you with "missing the bus," most simply pass the bus. Our new CompuStar, however, eliminates the bus problem altogether. Not to mention the processor problem. Even the expansion problem. Prove it to yourself. Call today about our 31-day trial offer. Oh, and by the way, the next time anyone asks, tell 'em you know where the bus stops.



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LETTERS TO PC MAGAZINE

SUPPORTIVE REVIEWS

I read with incredulity and disbelief your Editor's Choices ("Take It or Leave It: Portables with Desktop Power," *PC Magazine*, October 11, 1988). The words *warranty*, *service*, and *support* don't appear



one single time in your review. Do you think these words might matter to an end user who has gone out and invested \$5,000 in a computer system?

Clark Atkins
Kirkwood, Missouri

I believe that your reviews of computer products should include the quality of the technical support the company provides. Two recent experiences with software companies have gotten my gander up. If I had been aware of their support policies, I would have thought twice before making the purchases. *PC Magazine's* reviews of these products were at least partially responsible for influencing my purchase decisions.

Glen Susser
New Milford, New Jersey

PC Magazine is aware of the support issue and hasn't found an easy solution to the difficulties of evaluating it. See Bill Machrone's column "Support: The Stumbling Block" in our November 29, 1988, issue.—Ed.

GETTING THE LAST LAUGH

If my old 8088 is doing the job in a satisfactory and timely manner and I see nothing happening on the leading-edge computers that I can't do on my "obsolete" machine, then why should I be concerned ("Feelings of Inadequacy: Capitalist Tool," Stephen Manes, *PC Magazine*, September 27, 1988)? So what if my colleagues laugh at me. When I finally do upgrade, it will be to a proven technology that has gone past the infancy and buggy stages into a fully developed, workable system.

S. R. Perry
Vallejo, California

WINNING IDEA

I was pleased to read Bill Machrone's comment that "a magazine is a magnificent random-access device" ("Computer Magazines' Electronic Spinoffs Give Readers a Quick Way to Talk Back," *The Wall Street Journal*, October 19, 1988). For years I have been an advocate of the concept that a properly designed and bound document is indeed a very good random-access device, but I have found few who can appreciate this idea.

Henry W. Woolard
Fresno, California

THE RETURN OF XYWRITE

I believe we can now lay to rest the question of the alleged difficulty with learning and using *XyWrite III Plus*. The newest version contains *XyQuest's* A La Carte Menus, which provide an excellent point-and-shoot capability.

XyWrite has always been the acknowledged speed demon of advanced word processors, and now it is as easy to use as any word processor in its class. When the word

gets out, I expect that *XyQuest* will finally capture the market share that its clearly superior product deserves.

Dr. Stephen Risik
York, Pennsylvania

A NOVEL XPANSION

Once again, *PC Magazine* and Michael J. Mefford are to be commended for coming up with an innovative and useful tool that is also a good learning device for software developers ("Resize Your EMS RAMdisk on Demand," *PC Magazine*, October 31, 1988). *XPANDISK* is the first disk I've seen whose dimensions can be changed dynamically. Keep those interesting programs coming!

Ben Myers
Harvard, Massachusetts

TOO MUCH TOO LATE

It is a mistake to call the NEC UltraLite a 4.4-pound laptop (First Looks, page 33, *PC Magazine*, November 15, 1988). With a 2-hour battery life, this machine is really a 5.6-pound, two-piece pain.

Remember the Convergent Technologies Workslate? That machine weighs 3 pounds and measures 1 by 8½ by 11 inches. Features include a built-in 300-bit-per-second modem and a micro-tape drive, and the Workslate feeds its own battery-powered micro-printer, which measures 2 by 5 by 8½ inches. And, while it's not as powerful as the UltraLite, it was available 6 years ago.

Douglas M. Rapp
Battle Creek, Michigan



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LETTERS

THE MYBASE MYTH

I feel Donald Trivette's comments regarding *MyBase* were misleading (First Looks, page 56, *PC Magazine*, October 11, 1988). I have used *MyBase* for several months in a retail location and have found it to be superb. *MyBase* imports my inventory database to make pocket-size cross-reference books, cross-references my customers' resale tax numbers, and allows me to place memos in the listings. More programs should be as easy to use, and as well supported.

Steven Grad
Deer Park, New York

SOUTHERN EXPOSURE

John C. Dvorak's comment on the Americanization of the South reflects poorly on his judgment and his respect for the rich diversity of our nation ("Canada, O Canada," *PC Magazine*, October 31, 1988).

No region has a monopoly on "Americanization." The contributions of Tennessee Williams and Van Cliburn are equally as important to the tapestry of American culture as those of Arthur Miller and Beverly Sills. The backyard barbecue rivals the role of the block party and the Southern drawl compares favorably with the accents of Brooklyn or New England.

Stephen S. Entman
Nashville, Tennessee

I must protest the prejudice of your acerbic columnist, John C. Dvorak. It is one thing to rail against products, but quite another to rail against people. In one article, Mr. Dvorak managed to "trash" millions of people in Canada and, for good measure, several million in the southern United States ("Canada, O Canada").

"Americanization" is certainly not the apex of civilization. In fact, many people would say otherwise. If the people of Canada and south Alabama have resisted the kind of "Americanization" that Mr. Dvorak seems to espouse, I say good for them.

Charles E. Chaple
San Clemente, California

As an American living in Canada, I am very disappointed in John C. Dvorak's highly prejudiced view, which is based on a 1-day visit ("Canada, O Canada"). His xenophobic view of anything that is not

■ Mr. Dvorak's viewpoint brings to mind the "Ugly American" we experienced with Nixon's visits to South America.

"American" is rather pathetic. He even insults his fellow Americans from Alabama and the rest of the South. I wonder what his definition of "American" is? His viewpoint brings to mind the "Ugly American" we experienced with Nixon's visits to South America.

Kathlene Willing
Toronto, Ontario
Canada

John C. Dvorak should be told that the majority of Canadians are against the Free Trade Agreement, and that it is only because we have political freedom and three parties that the Conservatives, with only 42 percent of the vote, are going to get their way ("Canada, O Canada").

K. Taylor
Niagara Falls, Ontario
Canada

Canada's historic economy has been one as a supplier of resources to the U.S. ("Canada, O Canada"). Our resource-based economy is victim to a periodic boom-and-bust cycle because we're dependent on the health of the U.S. markets. Because of the stormy international economy of the present day, and because of an uncertain U.S. role in the global marketplace, many Canadians feel that it's time to diversify our economy and lessen our dependence on the U.S. economy.

Our software industry is one that is often held up as a model of economic diversification. The free trade deal will weaken our

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It's 11:05am. If you had our accounting software, you'd know where your business is.

11:05

"Great, back orders are down. Now let's push those sales."

11:06

"Gross Margins look good. We can pick up sales volume with some promotions."

dPayables MultiNet Praxis Products, Inc. Business Status Report as of 09/26/88			
dInvoice/dStatements		dPayables	
Current Balance:	186532.63	Current Balance:	54632.21
PTD Billings:	55768.15	PTD Payables:	23656.44
PTD Receipts:	53422.23	PTD Payments:	25978.84
PTD COGS:	22475.84	Approved to Pay:	1285.95
Inventory Value:	158412.57		
dOrders		dPurchase	
Open Orders:	8253.76	Open POs:	49783.56
PTD Orders:	54725.43	PTD Orders:	45125.33
PTD Shipments:	55835.12	PTD Receipts:	14937.49
PTD Gross Margin:	33292.31	Net Cash Forecast:	18378.62
Enter Choice (Forecast/Recalculate/Print/Quit) →			

11:07

"Let's forecast where these numbers will be at the end of the month."

11:08

"Last week's cash forecast was \$4,000. We're looking much better. We can put some into CD's."

11:09

"Cash receipts are up, I can approve a few more P.O.'s."

11:10

"Purchase Orders are close to sales this month. I'll call Mary and put the brakes on any more P.O's for a while."

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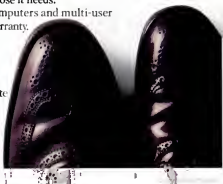
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■ LETTERS

ability to plan our own economy at a time when we need it most, and possibly cripple such growing industries.

Stuart Morris
Whitehorse, Yukon Territory
Canada

Canadian releases of most software come months after the American release and are almost always more expensive here ("Canada, O Canada"). Many users are

■ It's unlikely that the economy of the U.S. will feel more than a brief tremor if the Free Trade Agreement is approved.

forced to buy gray-market software to support their fresh software, imported from the U.S. by a broker. This is usually a much cheaper alternative to buying the "Canadian" release.

Maybe free trade will mean a better market for users, if it can stop the manufacturers from ignoring (or ripping off) the Canadian marketplace.

Greg Potts
Scarborough, Ontario
Canada

Many Canadians are wary of the proposed Free Trade Agreement simply because no one can guarantee its exact effects on our country, its economy, and our way of life ("Canada, O Canada"). Our approach to business affairs is a conservative one, and we prefer the thoughtful to the reckless.

It's unlikely that the economy of the U.S. will feel more than a brief tremor if the Free Trade Agreement is approved, but it may have devastating results within our proportionately smaller population. Some of us feel that it would be better not to get into bed with the elephant—the risks are too great.

Gary Wagner
Inuvik, Yukon Territory
Canada

What's holding up the free trade deal? Canadian opinion. We don't all consider such a deal to be a benefit to Canada—as the egotistical Mr. Dvorak seems to think we should ("Canada, O Canada").

Murray McKenzie
Toronto, Ontario
Canada

Some Canadians fear the Free Trade Agreement ("Canada, O Canada"). This is mostly due to the difference in the sizes of our mutual economies. Whilst the biblical story of David and Goliath may be charming and reassuring spiritually, we all know what would happen in the streets of New York City under the same conditions.

Andre Mallette
Saint-Leonard, Quebec
Canada

OVERLOOKING THE OBVIOUS

The author of the *VersaCAD* Design review ("High-End CADD: Expanding to New Directions," *PC Magazine*, August 1988) appears to have been unable or unwilling to come to grips with some quite elementary aspects of a package that tyro CADD users find immediately productive.

Reviewer Caroline Halliday seems to have totally ignored Joel Orr's suggestion of talking to existing users.

Failing to advise readers that the 2-D module can be purchased separately as a standalone module is a serious omission because the average drafting office gains at least 80 percent of its revenue from 2-D work. In addition, some of the comments about the Multiline and Modify functions are misleading, and the paragraph on menu hierarchy and structure is drivell.

Bruce Bowditch
Mentone, Australia

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CIRCLE 286 ON READER SERVICE CARD

■ JOE DESPOSITO

PC ADVISOR



Advice on creating customized help menus, software for linking computers through serial ports, locating software to manipulate scanned images, and information on PIMs.

HELP WITH HELP MENUS

I frequently use programs that have inadequate help or reference screens. I can keep several lists of reference details taped all around the edges of my monitor or bind them into a book that I keep picking up and putting down, but somehow this seems contradictory to the whole idea behind using a computer. Is there such a thing as a TSR utility or program that I could use to pop up my own customized help screens when I need them?

Fred W. Erickson
Orem, Utah

In the December 22, 1987, issue of PC Magazine, there is an article entitled "Scratch Pads and Annotators: TSR Notes to Yourself." The class of software reviewed in this article is aimed at keeping notes, scribbles, and random comments at your fingertips. These pop-up notetakers fall into two basic categories: those that are essentially memory-resident scratch pads and those that let you attach notes, as you write them, to other applications.

From your comments, it seems that you would be more interested in the former: memory-resident scratch pads. The product that won the Editor's Choice in this category was Tomado from Micro Logic Corp. (100 Second St., Hackensack, NJ 07602; (201) 342-6518). Tomado is memory resident and thus available by pressing a hotkey (Alt-J). To create a note, you simply tap N. A small window, which becomes the electronic equivalent of a blank piece of paper, opens up on your screen. You type whatever you like in the window, and

Tomado creates a record for it and indexes the content of each note. To retrieve information, you press G, and then type any word or phrase that's in the note you're looking for.

A more recent review of Tomado appeared in the December 13, 1988, issue of PC Magazine, where Tomado was reviewed with a category of products called personal information managers. Tomado has a suggested retail price of \$99 (a scaled-down version of the product, called Mini Tomado, is also available for \$49.95).

A product that will let you create help menus in a more formal way is The Norton Guides from Peter Norton Computing (2210 Wilshire Blvd., #186, Santa Monica, CA 90403; (213) 453-2361). The Guides are mainly pop-up help menus for programmers for such languages as Microsoft C, Borland Turbo C, Microsoft QuickBasic, and others. However, the

Guides also include a built-in compiler that allows you to create databases of your own, complete with an electronic index and cross-referencing. The compiler is the same one used to develop the Guides' databases. Suggested retail price of the Guides is \$100.

LINKING WITHOUT LANS

I would like to tie three computers together to share an appointment calendar, but I don't want the expense and complications of a LAN system. Is there a program that will allow access through a serial or parallel port to do this?

Ed Polz
Murphysboro, Illinois

The type of product you're looking for is often referred to as a local area link. Among the available products, the one I recommend is BoxNet (BOX #1, P.O. Box 1, Bath, NY 14810; (800) 541-2691).

Since BoxNet uses your PC's serial port as the link between computers, the maximum speed it can achieve is 115 kilobits per second. The topology of BoxNet is distributed peer-to-peer, which lets every node on a network communicate with every other node.

The BoxNet starter kit, which sells for \$179.90, contains two floppy disks (either 5¼- or 3½-inch), two BoxNet network adapters, one 25-foot RJ-11 cable segment, and a user's guide. The network adapters are the key to BoxNet. Inside what looks like an ordinary RS-232 serial connector shell is a custom integrated circuit chip that does the proprietary address

■ Is there a commercial TSR utility or program that can be used to pop up personally customized help screens when they are needed?

■ PC ADVISOR

decoding for the network. Additional nodes cost \$89.95.

USING SCANNED IMAGES

I have recently purchased a scanner and would like to "play" my scanned pictures. Unfortunately, I'm not familiar with the picture formats (.PCX, TIFF) that I get from the scanner. Please give me some information on these two formats or tell me where I can find a description of them.

B. Yuan
Fribourg, Switzerland

In order to use the file formats produced by your scanner, you must locate software that accepts files in both of these formats. PCX is a file format used by PC Paintbrush Plus (Z-Soft, 1950 Spectrum Circle, #A495, Marietta, GA 30067; (404) 980-1950), which has a suggested retail price of \$149. TIFF, which stands for tagged-image file format, can be used with most

desktop publishing programs.

A more thorough explanation of these and other file formats can be found in the October 13, 1987, issue of PC Magazine.

SEEKING AGENDA INFO

I am interested in learning more about Lotus's new product Agenda. From the ads it sounds like a useful product, but I want to know more before I spend the several hundred dollars Lotus wants for the product. Are there any other programs with similar features? How do the competitors compare? Our office already has a database. Couldn't we use it to perform the same functions that Agenda does?

Mindy Smith
Dallas, Texas

Agenda (Lotus Development Corp., 55 Cambridge Pkwy., Cambridge, MA 02142; (617) 577-8500) fits into a category of products that we at PC Magazine call

personal information managers (PIMs). Products that we believe fall into this category were reviewed in the December 13, 1988, issue.

If you read the article, one thing you're sure to notice is the diverse nature of these products. Although all are categorized as PIMs, each company's offering deals with personal information management in its own way. That article should help you understand the issues better, answer your questions, and eventually help you decide on the right product.

By the way, our reviewer states that Agenda is an extremely powerful tool for managing and structuring bits of everyday personal information.

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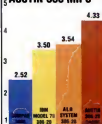
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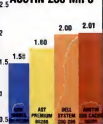
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800-400 CYCLES/sec. internal processor	YES	NO	NO	NO	NO	NO
Built-in mouse port	YES	NO	NO	NO	NO	NO
Manufactured made in U.S.A.	YES	NO	YES	NO	NO	NO

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FIRST LOOKS

Ami: Samna's \$200 Windows-based Word Processor Goes for Style

PC HANDS ON

BY CRAIG STINSON

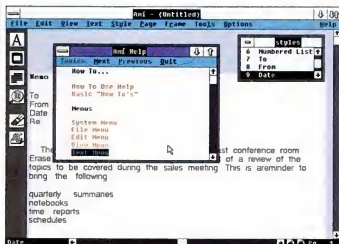
Writing is a text-centered activity. *Microsoft Windows* is a graphical environment. So why write under *Windows*? Two of the better reasons are to get graphics-assisted (WYSIWYG) formatting and to take advantage of *Windows*' Dynamic Data Exchange capability.

The newest *Windows*-based word processor, Samna's *Ami*, Version 1.0, ignores DDE; you won't be able to program "live" connections between *Ami* documents and, say, your favorite *Windows* database program. But *Ami* is long on formatting services, and—particularly for those who write short

documents that need a lot of visual punch—its formatting strength compensates nicely for

the slowness inherent in the graphics environment.

Ami's formatting capability



Ami's Help screen comes up in a window that, like other windows, can be sized and moved, which means that you can leave it on while you work.

is built on two constructs: *style sheets* and *frames*. A style sheet is a stored set of formatting instructions. A frame is an island within a document—a region whose formatting is not affected by that of the main document. Frames let you import graphics into *Ami* documents and flow text around them.

The style sheet concept will be familiar to *Microsoft Word* users, but *Ami*'s style sheets differ significantly from *Word*'s. First, every *Ami* document is attached to some style sheet; the new-file command automatically presents you with a dialog box forcing you to choose from a list of style sheets. Second, *Ami* style sheets can include text as well as formatting.

(continues on page 35)

\$150 Perspective Junior Keeps The Best of Boeing Graph

PC HANDS ON

BY MARY KATHLEEN FLYNN

Perspective is back, and it's cheaper and easier to use than ever. After capturing the hearts of graphics-lovers everywhere—at *PC Magazine*, we gave it a Technical Excellence Award for 1986—the presentation graphics package dropped out of sight. Apparently, it had a bumpy ride at Boeing. But now *Perspective* has come home to Three D Graphics, where it's been streamlined, renamed *Perspective Junior*, and launched

again. Its spectacular 2-D and 3-D graphics still make the most jaded computer journalists ooh and ahh.

At \$149.95, *Perspective Junior* is a whole lot less expensive than it was while under Boeing's wing. There, it went by the name *Boeing Graph* and was sold as a \$395 companion to *Boeing Calc*. To add insult to injury, Boeing canceled its licensing agreement in late 1987, and the program's been in a holding pattern until now.

As its new moniker suggests, *Perspective Junior* is slightly less powerful than earlier models. But what *Junior*

lacks in power, it makes up for in ease of use.

Besides the price, the biggest improvement in *Perspective* is its smoother navigation. Gone are the labyrinthine levels of the earlier incarnation. With *Perspective Junior*, you'll never have to press Esc more than four times to get back to the main menu. Hopping around the menus is pretty intuitive, and context-sensitive help is there when intuition fails.

From the main menu, you use function keys to reach the five submenus: Graph Types, Viewing Angles, Data Manag-

(continues on page 34)

HANDS-ON INDEX

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TURBO EMS

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Perspective Junior

(continued from page 33)

er, Files and Output, and Custom Options.

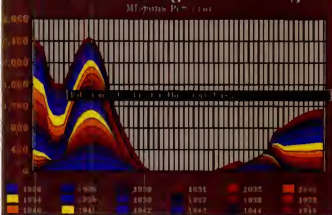
Graph Types is a single screen with pictures of *Perspective Junior*'s 13 3-D graphs and nine 2-D graphs. Choosing a graph couldn't be simpler: Just put your cursor on the one you want and press Enter, and *Perspective Junior* draws the graph you selected. The Viewing Angles screen works the same way, showing nine preset viewing angles. (You can also customize viewing angles in the Custom Options module.)

Of course, simplicity comes at a price—flexibility. *Perspective Junior* can't handle some things its predecessor could—like 3-D stacked graphs, multiple-page data, and a variety of label sizes. But most users will agree that the payoff in ease-of-use is worth the sacrifice of these features.

What you will miss in *Junior* is a working spreadsheet—unless you splurge for the \$69.95 Special Option Pak, which also includes support for plotters and Polaroid Palette Plus.

Junior's Data Manager looks like a spreadsheet, but don't be fooled. It's just an entry form for the data you want to graph—it can't perform any calculations. As such, manipulating data is awkward because you have to keep exporting the file to a spreadsheet and then importing it back to the Data Manager. Although *Perspective* can read .WKS, .WK1, ASCII,

Soil Erosion in Agua River Region



A 2-D Relative Stacked Area graph illustrates the same data as the 3-D screen image below. *Perspective Junior* tells you when your graph won't display all your data.

.ASC, .DIF, and .SYLK files, it can only write to ASCII and to two proprietary file formats.

Unfortunately, you can't just load up a 1-2-3 file from within *Perspective Junior* (although a glance at the File Manager makes you think you could). First, you have to load 1-2-3, choose FILE, then XTRACT, then VALUES, and then define the range of values to extract, keeping in mind that *Perspective* has a limit of 4,096 cells. Then you can load *Perspective*, go to the File Manager inside the Data Manager, and load the data file. Even if you do it right the first time, the process is tedious and time-consuming.

Exporting is also annoying. When *Perspective* saves a worksheet as an ASCII file, it doesn't save the structure of the data. So your data ends up running together, sometimes in blocks that are too big for pro-

grams like 1-2-3 to accept.

In addition to the import/export business, the Data Manager comes with its own irritations. Trying to make sense out of it is reminiscent of getting lost in the bowels of *Boeing Graph*. Instead of prompting you for labels, the Data Manager makes you move through layers of submenus to define ranges for data, titles, subtitles, and headers. (Three D Graphics believes this is an advantage when it comes to importing spreadsheets.) If you change a parameter that affects any other parameter, you have to go back and update the other by hand—I kept wishing *Perspective Junior* would do that automatically for me.

Similarly, if you add or delete a row or column, you may have to adjust your data range and redefine your parameters. My final complaint about the Data Manager is that in order to see how your tinkering will look, you have to Esc out of the Data Manager and into the main menu to draw the graph.

By contrast, *Perspective Junior*'s Print Manager—located logically enough in the Files and Output submenu—works like a charm. (*Perspective Junior* supplies drivers for most laser and dot matrix printers, HP PaintJet, Xerox 4020, and Tektronix 4696.) Through a WYSIWYG preview of the page, you can see how each of the five different box patterns and five different 3-D riser patterns will look on your graph. With Page Setup—a new feature—you can easily adjust the position and

size of the graph on a page.

Another new feature in the Files and Output submenu is the Slide Show Manager, which lets you put together an on-screen slide show. If you want to make a real slide show, however, you'll have to buy the Special Option Pak.

Perspective Junior supports Hercules, CGA, EGA, Super EGA, and even VGA. (So did the final version of *Boeing Graph*, but it was only on the market for 6 months.) You can play with color at almost any point in the program. The cursor keys let you cycle through palettes, and the PgUp and PgDn keys allow you adjust colors within a palette. In addition, the Custom Options submenu lets you change the color of particular portions of the graph.

In making *Perspective Junior*, Three D Graphics has done a good job of improving ease of use while maintaining enough flexibility for most users. And they've done a great job in bringing down the price, making *Perspective Junior* as inexpensive as 2-D-only packages like *Graph-in-the-Box* and *PFS:First Graphics*. Of course, the best thing about *Perspective Junior* is the gorgeous 2-D and 3-D graphs it makes.



FACT FILE

Perspective Junior

Three D Graphics
860 Via de La Paz
Pacific Palisades, CA 90272
(213) 459-8525

List Price: \$149.95; Special
Option Pak, \$69.95.

Requires: 512K RAM,
graphics display, DOS 2.1 or
later.

In Short: Though slightly less powerful than its predecessor, *Perspective Junior* makes generating spectacular 3-D graphs much easier. New features include an on-screen slide show, page setup, and support for PageMaker and Ventura Publisher. Not copy protected.

CIRCLE 457 ON READER SERVICE CARD



Perspective Junior's 3-D Spectral Mapped Contour Surface graph, which creates a surface from numerical data, is aimed at scientific and engineering applications.

Ami

(continued from page 33)

Having text built into the style sheet violates the principle of separating text and formatting, but the violation makes sense. Samna has correctly perceived that in many standard documents (memos, for example) certain text elements (such as the to, from, date, and subject headings) belong to the document's skeleton, not to its flesh. Those *Ami* style sheets that do include text may be used either with or without their verbal contents, so *Ami* lets you have it both ways.

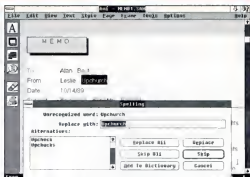
The style sheet's contents may include bullets and numbers for numbered lists. The latter are really numeric variables; *Ami* displays and prints the correct numbers no matter how you rearrange the list.

Samna includes 26 prede-

to a paragraph, you just put the cursor anywhere in the paragraph and click the mouse on the desired element (or press the function key that you've assigned to that element). Changing style parameters and creating new style sheets is just as easy. Gorgeous dialog boxes guide you through the entire process and let you see the effect of any changes before you return to the document.

One important shortcoming in *Ami*'s style-sheet implementation: nothing in the normal screen display tells you the name of the current style sheet.

Frames in *Ami* can hold either text or graphics. The program supports the .PCX Version 3 and .TIF Version 4 file formats, as well as all graphic formats supported by the Windows Clipboard. Putting text in a frame is handy for such things as making drop capitals to mark



Ami contains a decent spelling checker, which pops up like the Help screen. Unfortunately, the package doesn't have a thesaurus yet.

over the frame (so there's no text to the left or right of the frame). Or you can simply run the text through the frame as though it weren't there—specifying whether the frame contents are either transparent or opaque.

So much for the good news. What's less than fabulous about *Ami* is the relatively slow screen update that comes from working in a graphics environment. However, in order to cope with this constraint Samna included a "draft mode" in which *Ami* displays words only—with no formatting whatsoever. For maximum speed, you can work blind in draft mode and just toggle in and out of "layout" mode when you want to check how things are going to look on paper.

Writing in draft mode is something like writing in the Windows Notepad. The font is the same, and the screen performance is comparable. As any Windows user knows, you can move through a page of Notepad a lot more quickly than you can move through a page of Windows Write (which is comparable to *Ami*'s layout mode). But it's still nothing like blasting through a document while writing in *xyWrite*.

Three additional complaints: search-and-replace options are limited, and to search only, you have to specify a null replacement field; scrolling in layout mode is page oriented, which means you never get to see the end of one page and the beginning of the next at the same time; and the manual is quite a

bit on the light side.

Ami has no thesaurus, but it does include a decent spelling checker. It also has no merge capability. Look for more-advanced features such as these in *Ami Professional*, a souped-up version scheduled for shipment in the spring.

The bottom line? For short, highly formatted and/or highly standardized documents, *Ami* is a capable product and a pleasure to use. For plainer output and high-volume production, use your favorite text-based processor.

PC FACT FILE

Ami, Version 1.0

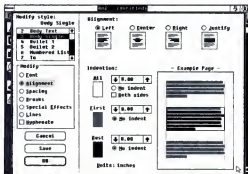
Samna Corp.
5600 Glenridge Dr.
Atlanta, GA 30342
(404) 851-0007

List Price: Introductory, \$149; after 120 days, \$199.

Requires: 640K RAM, 286- or 386-based computer, Microsoft Windows-compatible graphics display (Hercules, EGA, or VGA), hard disk, Windows-compatible mouse (optional), DOS 3.0 or later. Comes with current version of Microsoft Windows.

In Short: A style-sheet-driven, graphics-based word processor well suited for short, highly formatted documents. Not copy protected.

CIRCLE 455 ON READER SERVICE CARD



Ami's Modify Styles command lets you change a style sheet—a stored set of formatting instructions—and see your changes.

fined style sheets along with a booklet describing their use. The included style sheets are designed for memoranda, reports, overheads, newsletters, proposals, press releases, and books; within each category are sheets for casual (and dot matrix) use and others for formal presentations. The booklet effectively demonstrates *Ami*'s power to make beautiful documents and gently points out some aesthetic do's and don'ts.

Using *Ami*'s style sheets is a snap. A Windows "child window" lists the style elements defined in the current style sheet. To assign a style element

the beginning of major document sections.

When you create a frame, *Ami* presents you with a small box in the center of the screen. After sizing and positioning the frame, you can import your text or figure. A graphic, once installed, can be kept at its full original size, resized to fit the frame dimensions, or simply cropped to please.

A variety of "flowing" options let you control the way the main document interacts with the frame. You can have the main text flow all around the frame, like a stream around a rock. Or you can have it jump

Computer Database Plus: Fast On-line Searches of 70,000 Computer Articles

PC HANDS ON

BY GUS VENDITTO

After years of referring people to *PC Magazine* articles with my own overloaded memory as the search engine, it's a great relief to be introducing Computer Database Plus, an on-line service that will find articles in most every computer publication and print either the full text or an abstract to screen.

Now available as a menu choice from PC MagNet, Computer Database Plus holds every article that has appeared in *PC Magazine* since January 1987. The text from 47 other computer-related publications, including *PC Week*, *MacUser*, *Wall Street Computer Review*, *Mini-Micro Systems*, *Personal Computing*, and *Lotus Magazine*, is also here, plus abstracts from more than 50 others. There's a total of over 27,000 full-text articles and more than 43,000 ab-

stracts in the database.

That's a lot to look through, but searches go quickly. When I called at 2,400 bits per second, simple searches (finding all the occurrences of "Intel Above Board," for example) took less than 5 seconds. More-complex queries (all 1,043 articles in which both *Lotus 1-2-3* and macros are mentioned) took as long as 11 seconds.

Computer Database Plus can be accessed only through the CompuServe-PC MagNet network, which handles billing via credit card accounts; the huge database resides on a series of DEC VAX 8650s run by Information Access Corp. (a subsidiary of Ziff Communications Corp., publisher of *PC Magazine*). It's not cheap, with a \$24-per-hour surcharge added to the \$12 per hour billed by CompuServe. In addition, any full-text article you print to screen costs an extra \$1.50; abstracts, which can be lengthy, cost \$1. But if

you save old issues, the search facility may be all you need.

The software guides you through searches with menu choices. You can take a broad scattershot approach or use a more scientific method.

To begin your search with a wide net, you can choose to sift through every single word in the database for any term, product name, or person. You can combine terms, use wildcards, and do proximity searches.

For instance, I set out to find references to *1-2-3* macros that dealt with amortization. I began the search by selecting, from the menu, a search for words occurring anywhere. It prompted me for the search term, so I entered macro* and [1 2 3 and 123]

In 11 seconds, I was told that there were 943 references. Then I chose to narrow the search, this time adding "amortiz*" to the search string. Now I had a more digestible list of 23 hits to look at. When I entered "\$1," I received a scrolling list of the 23 references with issue dates and numbers.

You won't need any help to find your way through the Computer Database Plus menu options, but it helps to have a modicum of CompuServe savvy. For instance, it helps to know that entering M will bring you back to the menu you last selected; and prefacing any menu choice with S will get your response scrolling quickly, instead of pacing in, screen by screen. If things are going by too quickly, enter Ctrl-S to suspend a scrolling screen (hitting any key will start it up again); and type Ctrl-C to cancel an instruction that's executing.

Right now, the help files stored on Computer Database Plus are less than useful: they're confusing. Fortunately, improvements are in the works. While you'll find all of the articles in *PC Magazine* covered, you can't get at features tables

and code listings just yet. Some tables will be added in coming months as binary downloads; program code and executable utilities are from *PC Magazine* stories is available now on PC MagNet.

Computer Database Plus's performance speed is probably equivalent to *Computer Library*, the CD-ROM also published by Ziff Communications (see *First Looks*, page 46, *PC Magazine*, January 17, 1989); Computer Database Plus has the advantage of going back longer than the 1 year that *Computer Library* provides.

Computer Database Plus is a research tool, but it's probably going to be most useful as a way to better use old issues of *PC Magazine* and the other computer publications you read.

The ultimate test, I suppose, is whether you can find what you're looking for faster by dialing into Computer Database Plus or by poring through your back issues until you find the right page in the right issue. And that's a test of your own memory.

How to Join Computer Database Plus and PC MagNet

You need to be a member of either PC MagNet, *PC Magazine*'s on-line interactive service, or CompuServe to use Computer Database Plus. When you're ready to join, you'll need to have your credit card at hand, your modem turned on, and your communications software cranked up.

Set your communications protocol at 7E1 (7 data bits, even parity, one stop bit), and your modem at either 300 or 1,200 bits per second.

There are more than 500 phone numbers (at least one in every area code) but choose one of these for now: Boston, (617) 542-1796; Chicago, (312) 693-0330; New York, (212) 422-8820; or San Francisco, (415) 956-4191.

Have your software dial one of the numbers.

When the modem connects, press Ctrl-C. At the HOST NAME prompt, enter CIS. At the USER ID prompt, enter 177000,5000. At the PASSWORD prompt, enter PC*MAGNET. At the ENTER USER AGREEMENT NUMBER prompt, enter Z10D8903.

You're now in PC MagNet and can join conversations between readers and the editors, download utilities and batch files, or select the Computer Database Plus prompt from the menu. If you need to find a 2,400-bps access number or one in your hometown, enter GO PHONES from any prompt.

After you've used Computer Database Plus, you can return to PC MagNet by entering GO PCMAGNET at any prompt.

To sign off, enter BYE at any prompt.—Gus Venditto



FACT FILE

Computer Database Plus
Information Access Corp.
364 Lakeside Dr.
Foster City, CA 94404
(800) 227-8431

Requires: Modem (300, 1,200, or 2,400 bits per second) and communications software.
List Price: \$36 per hour (a \$24-per-hour charge is added to CompuServe's \$12-per-hour rate); \$1.50 per full-text article and \$1 per abstract printed to screen.

In Short: A 24-hour on-line service that offers searching through the full text of 48 computer-related publications.

CIRCLE 450 ON READER SERVICE CARD

BASICS

Roman
Helvette
Rockland
Chancellor

BASICS II

Roman Italic
Amertype
Big City
Optimis

DECORATIVE

Coop
Abbey
Beget
Orna

BOOK

Garamet
Basque
Centrum
Palatine

SANS SERIF

Avanti
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lots more. Glyphix fonts save you hours of downloading and megabytes of storage

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Grammatik III, RightWriter 3.0: Grammar Checkers Get Smarter, but Not by Much

PC HANDS ON

BY JONATHAN MATZKIN

Writers scoff at grammar checking software with the same nervous disdain that assembly line workers once heaped on industrial robots. The latest PC-based analyzers, *Grammatik III* (\$99) from Reference Software and

I constructed a booby-trapped paragraph full of badly misused words, comma splices, and run-on sentences. This literary atrocity came through *Grammatik III* and *RightWriter* virtually unscathed. Neither package objected to the sentence "Charley, that sweat boy, gave me some flours," though *RightWriter* did ask, inappro-

Prick III flagged "has a drink" and "the weather have," but only suggested a correction for the first mistake. Suffice it to say that neither program caught some very basic mistakes.

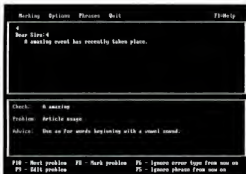
They are very good at catching certain writing weaknesses, however, like passive sentences, missing quotation marks, and, in some cases, faulty subject-verb agreement. The latter is a definite improvement over earlier grammar-checking software.

You can heavily customize both packages, but that defeats the purpose for users who want an expert to proof their work.

Both *RightWriter* and *Grammatik III* did well with subject-verb conflicts.

Grammatik III did a particularly good job of catching gender references, which has become increasingly important in business writing. Both *Grammatik III* and *RightWriter* allow you to "turn off" rules that you don't want the package to act on. So you could, for instance, prevent either package from routinely flagging every occurrence of the words *his* or *her*. *RightWriter* also lets you select different rules by specifying the kind of writing you are doing, whether it is business writing or fiction.

Both *Grammatik III* and *RightWriter* are simple to use.



Grammatik III's slick editing environment lets you fix problems in your document without returning to your word processor.

RightWriter, Version 3.0 (\$95), from RightSoft are improvements over earlier versions, but neither is likely to throw many scribes out of work.

Both programs now catch some mistakes they once ignored, and both have been significantly redesigned for greater ease of use. For the harried businessperson with too much to write and not enough time to write carefully, either program could be helpful. Anyone expecting the software equivalent of a human editor, however, will be greatly disappointed, since *Grammatik III* and *RightWriter* 3.0 still ignore many fundamental writing faults.

Grammatik III and *RightWriter* 3.0 use rule-based artificial intelligence techniques to analyze sentence structure. Both programs work fine within their knowledge bases but stumble when confronted with an unanticipated error.

prisingly, if I needed a comma after "Charley." Similarly, neither program found much wrong with "The cow jump over the moon when I get home I will have a drink of water the weather have being strange recently." *RightWriter* found nothing wrong at all. *Gramma-*



RightWriter, Version 3.0, generates an output file with comments merged into the text. You read and edit the file with your word processor.



FACT FILE

Grammatik III

Reference Software Inc.
330 Townsend, #131
San Francisco, CA 94107
(415) 541-0222

List Price: \$99; upgrade from *Grammatik II*, \$29.

Requires: 512K RAM, compatible word processor, DOS 2.0 or later. Not copy protected.

CIRCLE 439 ON READER SERVICE CARD

RightWriter, Version 3.0

RightSoft Inc.
4545 Samuel St.
Sarasota, FL 34233
(813) 922-0233

List Price: \$95; upgrade \$35 if earlier version bought before June 15, 1988 (upgrade free otherwise).

Requires: 384K RAM, DOS 2.0 or later. Not copy protected.

CIRCLE 439 ON READER SERVICE CARD

Either one can be run from the DOS command line or from a menu. While *RightWriter* generates an output file, with comments merged into the text, *Grammatik III* allows you to edit your document without returning to your word processor.

After you tap Alt-B to initiate *Grammatik III*'s analysis, the program throws you into its editor and highlights each suspected problem, allowing you to make immediate corrections if you choose.

RightWriter leaves your original input file unchanged and puts all of its comments in an output file. That seems less convenient than the on-the-fly editing *Grammatik III* permits, but you may actually prefer to have your original document left untouched.

For basic business writing, *Grammatik III* and *RightWriter* 3.0 offer help with some commonly found problems. Neither will truly edit your work, however. As in the past, they tend to overlook most fundamental grammar mistakes while reliably reporting some of the finer points of style and usage. 28



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Despite the sophistication of today's PCs, there's one thing they still don't do. And that's work the way people work: jumping from one task to another—from budgets to memos to phone calls and back.

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Software Carousel is the amazingly easy way to switch almost instantly from WordPerfect to 1-2-3 to dBASE to DOS to what ever else you want. Or go from one file to another in the same program. All without saving or retrieving—or wasting a precious moment of your time. Or your computer's memory.

It works by creating a number of independent software slots to load your programs into. You get up to ten of these software slots, so you can load up to ten programs.

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works with everything. Period. It even resolves conflicts among memory resident programs.

Other software creates a working environment that's complex, unfamiliar, with cramped little windows and strange commands. Software Carousel takes minutes to set-up just the way you want it. All your software looks and acts exactly as it always did. It's so downright useful, even IBM® recommends it.

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We think you'll agree, that with this kind of speed, convenience, and next-generation performance, \$79.95 is a small price to pay.

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Here's what people are saying about Software Carousel:

"Can't believe how well it works. Who needs 80386?"
—Ralph Evans, Attorney, Fullerton, CA

"Unlike other attempts (e.g. MS Windows, DesqView) yours works, is not fragile and does not intrude its 'personality' on everything that we do."
—Colm Ralph, Ralph & Partner, Inc., Seattle, WA

"Fantastic program. Great book. Saves me an hour a day! Thanks."
—Larry Pearsall, Rolling Hills Covenant Church, Rolling Hills Estates, CA

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—Walter Affioranti, West Islip, NY

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#6

CIRCLE 334 ON READER SERVICE CARD



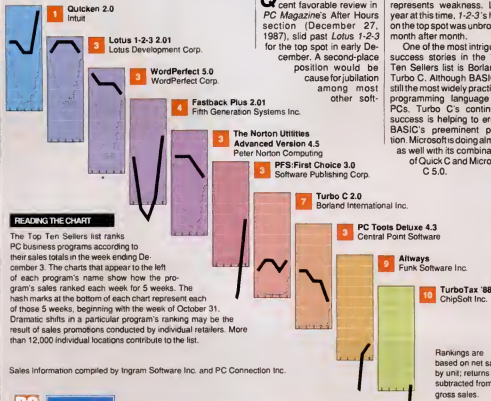
PIPELINE

TOP TEN SELLERS — A 5-Week History

Quicken, buoyed by a recent favorable review in *PC Magazine's* After Hours section (December 27, 1987), slid past *Lotus 1-2-3* for the top spot in early December. A second-place position would be cause for jubilation among most other soft-

ware makers, but for *Lotus*, it represents weakness. Last year at this time, 1-2-3's hold on the top spot was unbroken month after month.

One of the most intriguing success stories in the Top Ten Sellers list is *Borland's Turbo C*. Although BASIC is still the most widely practiced programming language on PCs, Turbo C's continued success is helping to erode BASIC's preeminent position. Microsoft is doing almost as well with its combination of *Quick C* and *Microsoft C 5.0*.



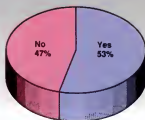
SURVEY

Integrated software is one of the quieter software categories; each of the major products receives regular revisions but fails to get the publicity that leaders in other categories receive, probably because the programs are unspectacular workhorses.

In light of recent upgrades to virtually every major program, we thought it was a good time to ask PC MagNet callers what they use. The biggest surprise was *Microsoft Works*, one of the newest entrants but clearly one of the most vibrant.

The surveys are open to all PC MagNet callers; see the sidebar "SMOOTH by Modem" in this issue's Utilities department for details on joining.

Is integrated software used in your company?



WILL COLOR LAPTOPS EVER BE READY?

The improvements we've seen in laptop screens over the past year have really been the result of manufacturers making use of existing techniques. Mitsubishi and Zenith made the greatest breakthrough of 1988 by putting fluorescent tubes behind their liquid crystal displays; others followed. Compaq produced the first VGA screen by taking a fluorescent-backlit LCD display and manipulating the pixel intensity with logic chips to such an extent that 16 distinct levels of gray are possible.

The technology needed to make the next leap is not likely to be so readily available. Both Sharp and Hitachi recently unveiled prototypes of portable computers with color screens that reveal a lot about the state of research in color displays.

Sharp found a way to add color with an ingenious but simple twist on current LCD technology; unfortunately, it's not a promising formula.

Sharp calls its technology "double super twist," meaning it uses twice as much of the technology used in other supertwist LCDs: two separate multilayer sandwiches are used on either side of an RGB filter to produce color VGA emulation. It can register 512 colors at a maximum resolution of 640 by 480.

Unfortunately, the resulting colors are weak and the text characters dull. Without major improvements, this is not a technology with much promise.

Hitachi, however, uses thin film transistors in an active matrix LCD to produce a screen with brightness and clarity equal to CRT monitors. The Hitachi prototype is a 640- by 200-pixel display in which each pixel comprises three separate dots, one each for red, green, and blue. A separate thin film transistor is used to switch each of the 384,000 dots in the display.

Hitachi uses an unusual arrangement of color dots in a stripe pattern. There's a separate horizontal line for each of the three colors, repeating every three rows down the display (a red stripe, then a green stripe, then a blue stripe). CRT monitors use a triangular pattern: each horizontal line is an alternating series of red, green, and blue phosphors; the lines above and below are composed of the same series but the color order is staggered. Thus an interleaved triangular pattern is formed, making characters more complex and reducing the distorted effect that could be

caused by using separate dots in generating uniform color. Clearly, Hitachi's color stripe pattern was devised to save expense in working with the filters that are placed over the transistor-LCD combination generating each dot.

When viewed at a normal distance, the images and characters are remarkably sharp and vibrant. But Hitachi has built only a small, 6.3-inch screen, and distortion may be a problem if the technique is applied to a more standard size.

In any event, Hitachi's success is encouraging and makes it likely that the first color laptops will be on sale in about a year.

The 486 Is Due in 1989

As the new year progresses, there's one product this column is certain to follow: Intel's 80486. Although leading software and hardware companies have been privy to the chip's specifications, as of this writing, Intel still refuses to discuss the chip's specs. Intel president Dave House recently confirmed that the chip will be fully compatible with its predecessor, the 80386, and would run DOS and OS/2.

Current speculation among hardware makers is that the first 486 personal computers will represent a twofold performance boost over 386 PCs, with a

price probably halfway between a 386 PC and a typical Sun workstation. The most likely application for such a flying machine would be sophisticated CAD software.

Two of the strongest rumors: it will incorporate the bulk of the math coprocessing features of the 80387; and it will be able to virtualize the 286, meaning multiple sessions of 286-specific programs (like OS/2) could be launched. This second feature makes new blockbuster server software possible.

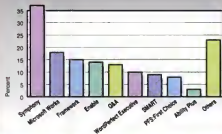
It's far too soon to speculate on the chip's speed. As of this writing the first 33-MHz 386 chips were in testing, and it's safe to assume that the 486 will probably ship at a speed higher than the fastest 386 then available.

Intel refuses to say when it will be ready, but you can expect that the first 486 PCs will not ship before early 1990.

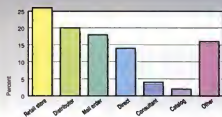
Meanwhile, Intel says it is developing a RISC (reduced instruction set chip) for the 80x86 line but refuses to say exactly what features it will offer. The most likely RISC chip will be a 386 designed to provide Lotus 1-2-3-style number crunchers with their dream machine. Other, application-specific chips are likely, such as RISC server chips.

—Gus Venittio

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Engineering Design Environment Links Sketches to Mathematical Models

PC HANDS ON

BY JEFF PROSISE

A big part of any engineer's job in designing mechanical or structural components is conceptualizing the design, analyzing it, and documenting the calculations on paper. CAD systems help in the conceptualization phase but provide little analytical support. *Mechanical Engineering Workbench*, a new software package from Iconnec, seeks to change all that by

assembled from "mechanisms." Four types of mechanisms are supported. Equations are entered in the Equation Mechanism. Input parameters are defined and assigned names and units in the Worksheet Mechanism, which has the same terse row-and-column format as a spreadsheet. Illustrations are created and constraints applied in the Geometry Mechanism. And detailed reports, which draw on the information contained in the other three mechanisms, are produced with

Mechanism will reflect the new input diameter.

ME Workbench even understands units. The default system of units can be set to CGS (centimeter-gram-second), MKS (meter-kilogram-second), English, or a user-defined combination. Type "1 in" in response to an input prompt with *ME Workbench* in CGS mode, for example, and it will automatically convert your entry to "2.54 cm." When you enter an equation in the Equation Mechanism, it calculates the correct unit notation for the result based on the terms on the right-hand side of the equation. It's even smart enough to recognize pounds per square inch as a pressure term and report it as "psi."

ME Workbench runs in a rich graphical environment based on Digital Research's GEM interface. Each mechanism occupies its own window. Under mouse control, windows are easily moved around the desktop and resized to larger or smaller proportions. One minor but annoying drawback to running an application based on GEM is that after it's installed, you'll suddenly find your hard disk's root directory cluttered with several GEM-related subdirectories. But it's a small price to pay for the convenience of the clean and

With *ME Workbench*, an engineer can define an equation, provide inputs, and get instant graphical feedback.

letting engineers play "what-if" with their designs the same way accountants play "what-if" with their spreadsheets.

ME Workbench might best be characterized as an engineer's spreadsheet. It allows the engineer to define the equations that govern a problem, provide inputs, and get instant graphical feedback on the results. Parametric design studies are a snap as you vary the inputs and gauge their effects on the output.

For example, to determine the end deflections of a cantilevered beam for a range of point loads, you would build a mathematical model with load magnitude defined as a variable. By entering a range of possible values and recalculating each time, you could quickly determine the resultant deflections. And by tying in a sketch illustrating the geometry of the beam, its end conditions, and the locations and magnitudes of the applied loads, you could set the problem up so that *ME Workbench* updates the sketch to show the beam's angle of deflection under each loading condition.

The components of a design problem—which *ME Workbench* terms a "project"—are

the Report Mechanism.

The beauty of *ME Workbench* is that all the elements of a design are linked together, even though they reside in different mechanisms. For example, if you construct a cylinder in the Geometry Mechanism and tie its diameter back to a value in the Worksheet Mechanism, changing the diameter within the worksheet will automatically update the sketch in the Geometry Mechanism. Results derived from the Equation

PC FACT FILE

Mechanical Engineering Workbench, Version 3.5

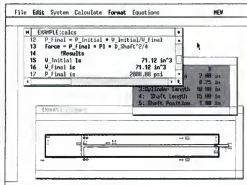
Iconnec Corp.
1501 Reedsdale St.
Pittsburgh, PA 15233
(412) 321-8890
List Price: \$2,950
Requires: 640K RAM, IBM PC AT or compatible, hard disk (10MB minimum), EGA with 256K RAM, math coprocessor, mouse, DOS 3.2 or later.
In-Short: A graphical design and analysis environment that lets engineers play "what-if" with their designs by linking sketches to mathematical models. Copy protected by parallel port key.

CIRCLE 440 ON READER SERVICE CARD

logical windowed interface.

The *ME Workbench* documentation is composed of a well-written Reference Manual housed in a three-ring binder, a Learning Guide, and a Techniques Manual. The 119-page Learning Guide provides a self-paced tutorial that steps you through the process of constructing and exercising a model gas piston. The Techniques Manual offers additional example problems and insight from the authors on how *ME Workbench* is and how it should be used. The overall quality of the documentation ranges from very good to excellent. And the \$2,950 list price includes toll-free telephone support and free upgrades for a year.

ME Workbench is not a drawing-production package in the same sense that *AutoCAD* and *Cadkey* are, although it does have provisions for IGES and .DXF output of geometric entities. It is easy enough to learn that you can expect to be analyzing real problems with it in a matter of hours. For the engineer who frequently finds himself iterating to reach an optimal design configuration, the cost of *ME Workbench* could be justified based on nothing more than the precious time it would save.



Mechanical Engineering Workbench helps you sketch your design problems. Sketches include such details as constraint placement and can be linked to mathematical models.

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An Easier Way to Manage Memory



HANDS ON

BY LORI GRUNIN

An expanded memory manager can be a valuable but all too arcane program: it's very easy to become entangled in memory addresses and page frame calculations when all you want is to stash your worksheets in that 3MB of memory.

Turbo EMS, which is actually an upgrade of Tele-ware's *Above Disc*, makes sense of the madness. (Don't be confused if you still see *Above Disc* in the stores: Tele-ware, the company that originated the program, has also upgraded the program and is still marketing it under the

same name.)

Like its predecessor, the program simulates expanded memory by swapping applications from DOS memory into the high memory. With *Turbo EMS*, the swap medium—the place that a file or application temporarily resides—can be on-disk or in extended memory.

The package conforms to LIM EMS 4.0 and therefore can address up to 32MB of expanded memory. It also sports a menu-driven installation and configuration program that makes configuring *Turbo EMS* almost rainless.

The installation program, supplemented by a useful manual, provides explanations of

each option and gives the information needed to calculate the number of 16K page frames you can allocate (each 64K page frame holds 4 16K pages). When calculating available memory, the software senses the presence of RAMdisks created with VDISK, IBMcache in PS/2s, and other expanded memory managers that use the highest memory possible (for example, *Microsoft Windows' SmartDrive*).

Turbo EMS handles some of the known problem children of memory management, such as *Windows* and *DESQview*, by providing custom page-frame alignments: the intrepid users can choose their own starting

FACT
FILE

Turbo EMS

Lantana Technology Inc.
4393 Viewridge Ave., Suite A
San Diego, CA 92122
(619) 565-6400

List Price: \$99.95; registered *Above Disc* users (Versions 1.0 to 1.3) may upgrade for \$40.
Requires: 256K RAM, DOS 2.0 or later. Not copy protected.

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memory addresses or even directly modify their CONFIG.SYS, bypassing the configuration program entirely. ☐

Word Processor Specializes in APA Style



HANDS ON

BY EDWARD MENDELSON

At a time when many programs try to be all things to all people, *Manuscript Manager: APA Style* is a jack of one trade.

If it's essential that your documents follow the format specified by the American Psychological Association, Pergamon Software's \$210 academic word processor will enforce conformity in page layout and print attributes. It takes you by the hand and leads you through menus that guarantee that your footnotes have every title underlined and every date in parentheses. It automatically capitalizes top-level headings and underlines a lower level. On request, it can scan a document and report that you neglected to insert text in a footnote or that you left the title page incomplete. If you want to cite the same book in more than one article, *Manuscript Manager* can store a library of references and let you import them without retyping.

Manuscript Manager, unfortunately, does a much less impressive job with any word processing function that isn't di-

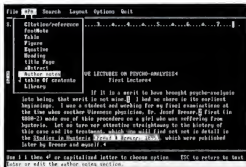
rectly related to APA format. The IBM version has been ported from an Apple II version with a few enhancements, but not enough. You get mail-merge, nonprinting comments, two editing windows, and a primitive redlining function that makes you specify redlined or strikethru text. But you'll find no spelling checker, and the package's editing and printing functions are startlingly primitive.

For instance, to delete a word you have to turn on a block, define the word, then delete it. You can select from a hundred printers, but you can't

use proportional spacing on any of them. You can't even name the file you want to edit on the DOS command line when you load the program.

Manuscript Manager is copy protected, and the setup routine leaves hidden files on your hard disk. You can install the program twice from the master disk. After that, if your hard disk fails, you won't be able to restore the program from a backup. *Manuscript Manager* uses a file format that no other software understands. It exports files only in ASCII.

Dragonfly Software's Note



Manuscript Manager; APA Style provides menus for all formats used in articles published in psychology journals.

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Requires: 512K RAM, DOS
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Bene is another package that supports APA style (and other academic formats), but it doesn't automatically support every detail—like underlining book titles. *Nota Bene* does automatically convert documents from one stylebook format to another, and it provides one of the richest sets of editing, printing, and textbase functions that is available from any word processor.

Although the American Psychological Association has approved *Manuscript Manager* as the official software version of its publication manual, individual APA members may find it easier to produce successful articles using less official software.

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Organization Chart Maker Stresses Flexibility

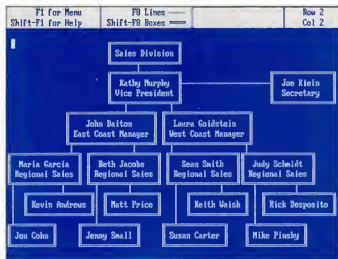
PC HANDS ON

BY MARY KATHLEEN FLYNN

If you want to create an organization chart quickly, easily, and inexpensively, try KD Systems' *Terrific! Organization Chart Maker*, a \$79.95 package designed specifically for the task you have in mind. Of course, you don't have to buy a package just for making org charts, but a full-featured graphics package may be more than you want. On the other hand, a word processor is probably less than you want.

Unlike its competitor, *Org Plus* (also \$79.95), which imposes a fill-in-the-blanks structure and does most of the drawing automatically, *Terrific!* excels in flexibility. *You* draw the chart. *You* determine the chart's structure. And *you* choose the reporting structure.

When you want automation, *Terrific!* is there to give it to you. Press F2, and a box appears around your text, which



Terrific! Organization Chart Maker lets you draw the org chart, rather than forcing you to fill in the blanks of a predetermined structure.

automatically gets centered. Press the Ins key, and you can draw lines with the cursor keys.

Terrific!'s Make Pretty feature will clean up your chart. It will center material, clean up lines, and arrange the chart in an aesthetically pleasing way. If you don't like the changes Make Pretty made, you can go back to your original chart.

Terrific! handles page preview superbly. You're always working on a screen that's about 90 percent WYSIWYG. In addition, one of the steps in the printing process shows you exactly what the chart will look like on the printed page. *Terrific!*'s screen and page-preview step are both far superior to the supposed page-preview feature

in *Org Plus*, which displays a small diagram of flashing squares.

If you're looking to buy a package designed especially for organization charts, *Terrific!* is well worth its price—particularly in comparison with *Advanced Org Plus*, which, for \$129.95, provides similar features.

PC FACT FILE

Terrific! Organization Chart Maker

KD Systems Inc.
P. O. Box 97024
Raleigh, NC 27624
(800) 345-3908
List Price: \$79.95
Requires: 256K RAM; printer (HP LaserJet Plus, Series II, or compatible; dot matrix; or character-based), DOS 2.0 or later. Not copy protected.

CIRCLE 453 ON READER SERVICE CARD

Irwin Crams 80MB on a Tape

PC HANDS ON

BY WINN L. ROSCH

IBM chose an 80MB internal tape system based on the small DC-2000 cartridge for its PS/2 models. Now the same drive is available in another guise as the Irwin 280. Using a proprietary embedded-servo storage format, the \$749 Irwin 280 is able to pack 80MB on 205 feet of 1/4-inch tape by stacking 32 tracks across its width. In addition, the firmware contains code support for 300-foot cartridges, which, when available, will stretch the system's single-cartridge capacity to 120MB.

Tapes must be formatted before use, a time-consuming process that also writes the servo information. Cartridges are available from Irwin with the servo tracks already written for

\$35; blank tapes sell for \$30.

The drive itself fits a standard 3 1/2-inch form factor. Installing it in a Micro Channel PS/2 requires a special \$100 adapter kit, the Irwin 8470. The kit includes a sled that attaches to the drive and lets it slide directly into any Micro Channel PS/2 drive bay. You can manually install the drive within half an hour.

As with other Irwin tape drives, the 280 takes advantage of your system's floppy disk controller instead of using a dedicated host adapter. While this strategy cuts the system cost, it prevents the use of a second floppy disk drive in your PS/2 and holds back the transfer rate of the backup system.

Compared with its 40MB predecessor, however, the 280 delivers dramatically improved performance: a 2MB-per-min-

ute backup rate. During testing, however, overhead functions such as indexing and building tape directories and headers stretched the total time needed to back up one 10MB file to 7 minutes, 42 seconds.

The Irwin 280's handling of elaborate directory structures is even more impressive. It backed up the PC Labs 1,500-plus directory, 3,000-plus file Scatter test environment in 18 minutes, 15 seconds.

The control software for the 280 is an updated version of Irwin's EZTape system, updated to Version 2.0. Offering both menu- and parameter-driven operation, the system is quick to put to work and easy to program. All normal file-selection options are available, including date, tagging, and by list.

Irwin's software is not without its faults. The performance

PC FACT FILE

Irwin 280

Irwin Magnetic Systems Inc.
2101 Commonwealth Blvd.
Ann Arbor, MI 48105
(800) 421-1879
List Price: \$749
Requires: Micro Channel PS/2, vacant floppy disk bay, Irwin 8470 installation kit (\$100).

CIRCLE 454 ON READER SERVICE CARD

of the menu-driven section of software drags when the disk directory structure gets complex, and the software deals only with files, offering no image mode.

The bottom line? The Irwin 280 isn't the fastest system available, but its numerous virtues—including an 80MB capacity—make it a good backup choice.

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CIRCLE 482 ON READER SERVICE CARD

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- Socket for an 80387.
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memory boards**

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- Western Digital 2F-2H Controller.
- 1.2MB Floppy Disk Drive.
- AT and OS/2 Compatibility.
- 220 Watt Power Supply.
- Socket for 80287 (daughter card for 80387).
- One 32 Bit Slot, Five 16 Bit Slots, Two 8 Bit Slots.
- Norton SI rating equals 205.

NEW

20MHz \$2,295 386-9

Up to 16MB of 32 Bit RAM. Sockets for Weitek, 80387 and 80287 on board.

- 80386 Running at 16/20MHz and 0 Wait State.
- 1MB of 32 Bit 0 Wait State Ram.
- Speed selectable for 8/16/20MHz.
- Clock Calendar with battery backup.
- 101 Enhanced Keyboard.
- 80386 Running at 16/20MHz and 0 Wait State.
- 512K of 80NS Ram.
- Speed Selectable for 6/12MHz.
- Clock Calendar with Battery backup.
- 101 Enhanced Keyboard.
- Western Digital 2F-2H Controller.
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- Socket for 80287 Coprocessor.

Model 286-1 12MHz

**\$1,095
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computers.**

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- Western Digital 2F-2H Controller.
- 1.2MB Floppy Disk Drive.
- AT and OS/2 Compatibility.
- 220 Watt Power Supply.
- Socket for 80287 Coprocessor.



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NEW ON THE MARKET

by Lori Grunin

FeedThru Modem Offers Solution To Serial Port Scarcity

Adding a modem to your system usually means using up a precious slot on your computer or attaching the device to your system's sole serial port. Xecom's FeedThru Modem offers a space-saving alternative: the 2,400-bit-per-second modem plugs into your RS-232 port and provides an RS-232 output port on the other side.

Since it has an internal power supply, the \$349 Hayes-compatible modem is ideal for laptop computers, according to Xecom. When the modem isn't in use, signals transmitted to the port travel directly to and from the second peripheral attached to the FeedThru. Xecom supplies *Mirror II* for communications and a converter cable for use with ATs and PS/2s.

Just in case you don't know what to do with this serial-port windfall, Xecom also sells the FeedThru Modem bundled with a Z-Nix Hi-Res Mouse, *TurboCAD*, and *Dr. Halo III* for \$499.

List Price: FeedThru Modem, \$349; with Z-Nix Hi-Res Mouse, *TurboCAD*, and *Dr. Halo III*, \$499. Xecom Inc., 374 Turquoise St., Milpitas, CA 95035; (408) 945-6640.

CIRCLE 442 ON READER SERVICE CARD



Xecom's FeedThru Modem connects directly into the RS-232 port of your computer.

Printer Controller Boosts Laser Printer Gray-Scale Output

Users of any of the Canon SX-based laser printers, including the HP LaserJet Series II, can benefit from the ability of the Microtek GLZ printer controller board to deliver output with resolutions of up to 150 lines and between 64 and 128 shades of gray. After replacing the undercarriage of the printer with the \$2,995 controller, you then connect the printer to the PC through a traditional Centronics interface.

The controller, which performs its gray-scale magic by varying the regular dot size produced by a standard 300-dot-

per-inch laser printer, features a programmable Motorola 68000 processor and 2MB of RAM on-board to handle graphics. Text and non-gray-scale images are output normally.

The Microtek GLZ provides support for various desktop publishing programs, including *Ventura Publisher* and *Page-Maker*. The controller is also offered as an option with Microtek's *TurboPrint*, a 300-dpi laser printer.

List Price: Microtek GLZ, \$2,995. Requires: Laser printer with Canon SX-based engine. Microtek Lab Inc., 680 Knox St., Torrance, CA 90502; (213) 321-2121, (800) 367-6933.

CIRCLE 446 ON READER SERVICE CARD

The NEC MultiSync 3D cabinet has a built-in tiltable base and a smaller footprint than its predecessors.



NEC Adds Two Monitors to Its MultiSync Family

Although both bear the NEC MultiSync name, only one of the two newest members of NEC Home Electronics' line of displays is a true frequency-switching monitor. The \$1,049 NEC MultiSync 3D offers compatibility with IBM's 8514/A display—interlaced 1,024- by 768-pixel resolution—as well as backward compatibility with lower resolutions and Apple's Macintosh II display.

While the NEC MultiSync

3D accepts both TTL and analog input, the \$799 NEC MultiSync 2A is a dedicated VGA monitor, accepting only analog input and supporting resolutions as high as 800 by 600 extended VGA.

Both monitors have a 13-inch viewing area and NEC's newly designed, smaller-footprint cabinet with concealed cable connections.

List Price: NEC MultiSync 3D, \$1,049; NEC MultiSync 2A, \$799. NEC Home Electronics Inc., 1255 Michael Dr., Wood Dale, IL 60191; (312) 860-9500.

CIRCLE 445 ON READER SERVICE CARD

HOT PROSPECT

\$595 80386SX Upgrade for 80286 Machines

Intel's 80386SX chip has been heralded as a way for people to run programs written for 80386-based machines without paying the stiff prices charged for them. Cumulus's 80386SX Card now makes it possible for users to reap the same performance benefits without having to scrap their old PC ATs.

The card, which has an area of less than 3 square inches, replaces any 80286 CPU with a clock speed of up to 16 MHz. Units operating at 8 MHz or slower experience a 15 percent improvement in performance, according to Cumulus. The company will also be offering an adapter for an 80387SX floating-point coprocessor.

List Price: 80386SX Card, \$595.

Requires: 80286-based PC. Cumulus Corp., 23500 Mercantile Rd., Cleveland, OH 44122; (216) 464-2211

CIRCLE 441 ON READER SERVICE CARD

NEW ON THE MARKET

**Bus-Mastering Token-Ring Board
For the Micro Channel**

The Cypress/2, a 16-bit Token-Ring adapter that can be configured as a bus master controller in Micro Channel systems, is Lantana Technology's recent entrant in the rapidly growing LAN adapter business.

The \$795 board features compatibility with existing Token-Ring networks, a 4-megabit-per-second data transfer rate, and comes with drivers for Novell's *NetWare*. All board settings are software-configurable. Options include 128K of on-board RAM to hold the IEEE 802.2 logical link software, a 32K EPROM module for the same purpose, and a RPL (remote-program-load) EPROM module for diskless workstations. Cypress/2 also has diagnostic LED indicators to aid troubleshooting LAN managers.

List Price: Cypress/2, \$795

Requires: 80286/386-based system, DOS 2.0 or later. Lantana Technology Inc., 4393 Viewridge Ave., Suite A, San Diego, CA 92123; (619) 565-6400.

CIRCLE 443 ON READER SERVICE CARD

**PostScript Adapter
Works with HP
DeskJet, Epson FX-80**

For those people who have stuck loyally by their dot matrix printers over the years but still yearn for PostScript-quality output, Everex's \$1,795 PostCard Plus printer controller gives Epson FX-80, HP DeskJet, and HP LaserJet printers and compatibles PostScript-emulation capabilities.

The full-length card fits into an expansion slot in an IBM PC AT or compatible and comes with Bauer Enterprises' PostScript interpreter, software that performs translations into HP's PCL graphics command set or Epson's FX-80 graphics com-

mand language. PostCard Plus employs a 16-MHz Intel 80C186 processor and an Intel 82786 graphics coprocessor to speed translation, according to Everex.

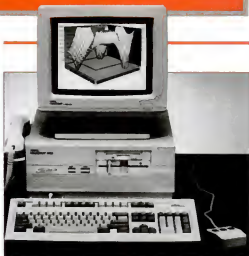
The standard 3MB of on-board memory is enough to hold the 13 Bitstream downloadable font outlines that Everex bundles with the card. For \$895, an additional 2MB provides enough memory to hold a total of 35 font outlines.

List Price: Everex PostCard Plus, \$1,795. **Requires:** 80286/80386-based system, DOS 2.0 or later. Everex, 48431 Milmont Dr., Fremont, CA 94538; (415) 683-2100.

CIRCLE 444 ON READER SERVICE CARD



The Everex PostCard Plus printer controller converts PostScript graphics into mapped graphics.



The Vendex HeadStart PRO comes with both 1.44MB and 1.2MB floppy disk drives.

**20-MHz 80386
Machines for Under
\$5,000**

Once a technology is no longer on the frontiers of change, economic forces conspire to push prices downward: three new 20-MHz 80386-based systems prove that they are no exception to the rule.

Standard features on the Vendex HeadStart PRO include 4MB of RAM (expandable to 16MB), a VGA graphics adapter, a 2,400-bit-per-second modem, and two high-density floppy disk drives—one 5¼-inch, one 3½-inch. A configuration with a 23-millisecond 80MB hard disk drive runs \$4,495. Users can choose between two 13-inch VGA monitors; a \$249 paper-white monochrome or a \$695 color display. DOS 3.3, six 16-bit slots, and one 32-bit slot complete the package.

Tussey Computer Products offers the \$2,499 Swan 386/20 configured with 1MB of RAM (expandable to 16MB), a 1.2MB floppy disk drive, and five drive bays—two 3½-inch and three 5¼-inch. Users can also opt for a system with a VGA card and monitor and an 80MB hard drive for \$3,678.

A stripped-down version of the CompuAdd 386/20, with

only a 1.2MB floppy disk drive and 1MB RAM (expandable to 16MB), costs \$2,295. The same configuration with a 110MB hard disk drive and a VGA-compatible monitor costs about \$3,845. The 386/20 has seven expansion slots—six 16-bit and one 8-bit—a math coprocessor socket, two serial ports, and one parallel port.

List Price: Vendex HeadStart PRO, 80MB hard disk drive configuration, \$4,495; monochrome display, \$249; color display, \$695. Vendex Technologies Inc., 40 Cutter Mill Rd., #438, Great Neck, NY 11021; (516) 482-4255.

CIRCLE 447 ON READER SERVICE CARD

List Price: Tussey Swan 386/20, \$2,499. Configured with 80MB hard disk drive, VGA card, and monitor, \$3,678. Tussey Computer Products, P.O. Box 1006, State College, PA 16804; (814) 238-1820.

CIRCLE 448 ON READER SERVICE CARD

List Price: CompuAdd 386/20, \$2,295. Configured with 110MB hard disk drive and VGA monitor, \$3,845. CompuAdd Corp., 12303 Technology Blvd., Austin, TX 78727; (512) 250-1489, (800) 531-5475.

CIRCLE 449 ON READER SERVICE CARD

WordPerfect 5.0



\$215
List \$495

The most popular word processor is now even better than ever! Version 5.0 adds multiple font support, graphics integration, page preview and much more. WordPerfect 5.0, still retains its feel and ease of use that made it #1. Combine this with the best support in the industry and you can't lose.

SPECIALS

TOSHIBA T1000 \$749



The Toshiba T1000 is the perfect, second PC! It comes with 512K of ram, a 720K floppy drive, a superb LCD screen and MS-DOS in rom! All this in a battery-powered 7 pound package. A 768K ram card is just \$269 and can be set as base, expanded, or a non-volatile ram disk.

TOSHIBA Printers



These 24 pin models are loaded with features and are priced right. You can select multiple fonts and pitches right from the menu-driven front control panel. With paper parking, you can insert a single sheet without removing the continuous form paper. All this and multiple emulations with no dip switches.

P321SL Narrow \$459
P341SL Wide \$629

HARDWARE

PRINTERS		
	LIST	FAST
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Citizen		
120D	229	145
180D	259	165
MSP40	449	299
Tribute 124	429	259
Tribute 224	899	599
Diconix		
150P	499	299
Epson		
Futaba	995	549
DL3400		
NEC		
P2200	569	339
P3300	799	509
PC390	1049	669
LC590	4799	2999
Okidata		
162 Plus	319	219
320	499	329
350	699	459
383 (Req. Interface)	1399	915
Panasonic		
KXP1080-2	299	159
KXP10911-2	329	189
KXP1134	529	315
KXP1595	749	419
KXP1524	949	519
Star		
NK1000	269	169
NK2400	499	319
NB2410	699	449
Toshiba		
P321SL	749	459
P341SL	999	629
P351SL	1499	929

BOARDS		
	LIST	FAST
AST	645	339
Hot Shot 286	845	119
Six Pak Plus 64K	210	
DTK		
286 10MHz M/B	499	249
XT 1.2mb FDC	79	45
Everex		
1200MHz Int Modem	149	69
2400MHz Int Modem	249	129
Genoa		
Super EGA Hi-Res+	399	189
Super VGA #5100	445	239
VGA Hi-Res #5200	645	399
Hercules		
Graphic Card + Intel	299	169
8087-2	250	149
80287-10	480	249
Above Board Plus	795	459
Designer VGA	545	309
Twin Turbo 286	445	269
Twin Turbo 12MHz	645	399
Paradise		
Autoswitch 480	349	169
VGA Plus	399	299
VGA Plus 16	499	299
VGA Professional	799	499
Practical Peripherals		
1200MHz Int Modem	99	65
2400MHz Int Modem	199	149
Protheus		
Promodem 2400B	199	129
Promodem 2400G	249	159

MONITORS		
	LIST	FAST
Magnavox		
7BM749 VGA	229	149
9CM082 VGA	649	419
Mitsubishi		
1405 RGB	399	259
1410 EGA	599	399
Diamond Scan 1361	799	489
MEC		
Multisync II	899	579
Multisync Plus	1399	869
Princeton		
Max15	389	Call
Ultrasync	849	479
Sony	1375	859
Selkirk CM1430	995	599
1302 Multisync	995	699
1303 Multisync	825	479
Zenith 1490	999	599

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	LIST	FAST
Clipper	699	Call
Database	600	379
dBase IV	795	449
dBase V	105	105
Filebase Plus	395	185
Paradox	725	399
Quartz	795	449
RapioFile	295	179
Release for DOS	900	419
Reflex	750	400
O & A	349	179
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Byline	295	175
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Pagemaker 3.0	795	Call
PFS First Publisher	129	69
Publisher's Pamphlet	285	149
Ventura 2.0	695	459
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	LIST	FAST
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Draw Applause	495	269
First Graphics	129	Call
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GEM Draw Plus	299	165
Genius CAD	49	99
Graph Plus	495	299
Harvard Graphics	495	Call
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First Choice	159	95
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Windows 286	99	69
Windows 386	115	117
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Logitech G? SerialBus	119	65
Logitech HiRes Bus	150	79
Microsoft SerialBus	150	95
Microsoft Win/Windows	200	129
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Curtis Ruby Plus	115	59
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Datashield 100	99	57
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Macro Assembler	150	79
Norton Guides (Specify)	100	58
Turbo Basic	99	58
Turbo C 2.0	149	90
Turbo Pascal 5.0	149	90
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Quick C	99	59
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Lapras Plus	140	77
Norton Advanced	149	74
PC Tools Deluxe	80	36
Sidexit Plus	195	119
XTree	70	34

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	LIST	FAST
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GEM First Word Plus	199	117
Grammatik III	89	49
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MultiMate Adv. II	565	247
Professional Write	199	105
Rightwriter	95	49
Spont	95	119
O & A Writer	199	119
Webster's Writer	60	47
Word	450	Call
Word Perfect	495	Call
Word Perfect Library	129	59
WordStar Prof. 5.0	495	219
XyWrite III Plus	445	299

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OPTune's All-in-One Disk Maintenance Defragments Files, Sets Interleave

PC HANDS ON

BY EDWARD MENDELSON

If your collection of hard-disk-testing and -maintenance utilities is threatening to occupy your entire hard disk, consider replacing them all with Gazelle Systems' *OPTune*.

This \$99.95 utility integrates into one program a variety of functions normally divided among separate packages. *OPTune* defragments files and packs them at one end of the disk. It tests the disk's interleave performance and can change the interleave while performing a low-level format that leaves the data intact. And it tests the disk with a variety of tests ranging from a quick surface scan to an all-day workout.

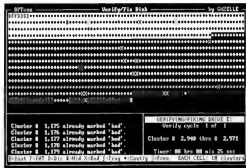
OPTune's defragmenter is startlingly fast. Although it outruns all rivals, it completely packs the disk yet lets you interrupt it safely by pressing a key. It doesn't include all the options and safeguards that you'd find in some defragmenter pro-

grams, such as Bridgeway Publishing's *FastTrax*, but it offers a unique combination of speed, safety, and thoroughness.

The low-level format and interleave functions work accurately with standard drives and partitions larger than 32MB. The program knows enough not to try to reformat or change the interleave on RLL disks—which is just as well, because its optimum-interleave test yields

wildly inaccurate results on such disks.

The function that tests the disk surface is reliable on any disk and uses test patterns that match the ones used by drive manufacturers. *OPTune* does as well as any program can that measures disk errors that have been filtered through DOS. It can't measure up to *SpinRite* or *Disk Technician*, programs that dig into the hardware for errors



OPTune can test the disk surface quickly or use bit patterns of varying complexity. The disk map (above) illustrates a quick surface test in progress.

PC FACT FILE

OPTune

Gazelle Systems
42 N. University Ave., #10
Provo, UT 84601
(800) 233-0383
(801) 377-1288
List Price: \$99.95
Requires: 256K RAM, DOS
2.0 or later. Not copy protected.

CIRCLE 432 ON READER SERVICE CARD

and irregularities.

OPTune fills out the package with an unformat program, a disk paker, and a CHKDSK equivalent that verifies a complex directory structure 20 times faster than DOS's version and gives a more detailed report when it's done.

OPTune's manual tries so hard to be accessible to nontechnical users that it tends to advertise rather than explain the program's functions. If you're reasonably knowledgeable about DOS, you'll find the built-in help screens and menus a lot more informative than the manual.

Two Information-Packed Books Attack The HP LaserJet from Both Directions

PC HANDS ON

BY EDWARD MENDELSON

Combine two books to learn everything you need to know about the care and feeding of the HP LaserJet.

LaserJet Unlimited, by Ted Nace and Michael Gardner, now in a rewritten second edition (Peachpit Press, \$24.95), covers hardware and software issues for all LaserJet models, from the original to the Series II—and everything in it applies equally well to the new HP LaserJet IID.

Nace and Gardner's no-nonsense prose leads you from the printer's control panel all the

way to the arcane commands that enable laser printing in applications not designed for lasers. Along the way, they offer street-smart commentary on products designed to make laser printing easier.

LaserJet Unlimited covers paper feeders, print buffers, control programs, font cartridges, soft fonts, font generators, font managers, drawing programs, graphics utilities, PostScript add-ons—everything except the \$30 dust cover you can buy from Hewlett-Packard. And their bug reports can prevent hours of frustration.

The appendices include a clear listing of LaserJet command codes and a catalog of car-

tridge fonts. And the book's hundreds of troubleshooting tips—obviously the fruit of long experience—more than justify the price of admission.

LaserJet Unlimited is designed mostly for the days when you want to get the best out of third-party software and hardware. When you want to get your hands dirty by experimenting directly with the LaserJet's command language, try Alfred E. Poor's *The Hewlett-Packard LaserJet Printer Handbook* (Dow Jones-Irwin, \$24.95). Poor uses simple BASIC programs to illustrate LaserJet functions ranging from simple margin changes to complex control macros. By the time you

PC FACT FILE

List Price: *LaserJet Unlimited*, Edition II, by Ted Nace and Michael Gardner, \$24.95. ISBN: 0-938151-02-9. Peachpit Press, 1085 Keith Ave., Berkeley, CA 94708; (415) 527-8555.

CIRCLE 433 ON READER SERVICE CARD

List Price: *The Hewlett-Packard LaserJet Printer Handbook*, by Alfred E. Poor II, \$24.95. ISBN: 1-55623-156-3. Dow Jones-Irwin, Homewood, IL 60430; (312) 798-6000.

CIRCLE 431 ON READER SERVICE CARD

work your way through Poor's exercises you'll be able to make the LaserJet do almost anything except lift itself off the table.

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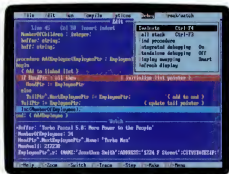
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Code: MA02

BORLAND

CIRCLE 137 ON READER SERVICE CARD

Paint Program Supports 256 Colors, 800 by 600 dpi

PC HANDS ON

BY LORI GRUNIN

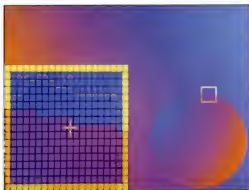
ColorRIX, a \$199 VGA paint program from RIX SoftWorks, contains a plethora of nifty features, such as 256-color support at a resolution of 800 by 600 dots per inch; a good, flexible airbrush; and a zoom that allows you to make changes on the enlargement while viewing their effect on the big picture.

Unfortunately, the program doesn't always perform as expected, or even as desired. After some operations, you have to move the mouse around—a lot—in order to find the cursor. When performing a fill on top of a pattern or graduated color, *ColorRIX* fills only one pattern element at a time. Since the area around an object must be defined within a rectan-

gle, you can't move or adjust an object without also dragging a chunk of background.

Most other paint programs use drop-down menus or ever-present icons; *ColorRIX* uses

pop-up menus instead. The advantage of pop-up menus is that the user can control where the menu appears on the screen so that it doesn't obscure a needed section of a work-in-progress.



ColorRIX's zoom feature lets you magnify and edit your pictures concurrently.

Some aspects of the *ColorRIX* menu system are irritating. For instance, instead of having one file menu from which to save screens and environment settings, these operations appear on different submenus. It's very easy to exit the program thinking you've saved your screen when you've saved only your environment.

At presstime, Version 1.1 was scheduled for release in late 1988; it's expected to provide 16-color support drivers and some bug fixes. As it stands, *ColorRIX* shows promise but isn't yet ready for prime time. **List Price:** *ColorRIX*, \$199.

Requires: 384K RAM, VGA graphics adapter, DOS 2.1 or later. RIX SoftWorks Inc., 18552 MacArthur Blvd., #375, Irvine, CA 92715; (714) 476-8266.

CIRCLE 435 ON READER SERVICE CARD

4c Lets Developers Edit C Code

PC HANDS ON

BY STUART R. GREENBERG

4c lets programmers view and edit C source code. The \$89 menu-driven package scans your C programs and creates a database of all the functions, globals, #defines, typedefs, and structures. Then, it lets you jump around C code without worrying about how it's structured or where it's stored.

4c's magic becomes apparent when you place the cursor on a function name and hit F9. A window containing only the code for the selected function suddenly appears. You can then edit that code, open other windows, switch between windows, or hit Esc to close the window. *4c* offers the same flexibility with globals, #defines, typedefs, and structs. *4c* keeps track of the parts of the files you're changing.

4c won't restrict you to its editor. Hitting Alt-X from any window calls up a temporary file with the text in your editor.

When you exit, you're returned to the updated file in *4c*.

With its Hypertext-like point-and-shoot functions, *4c* is ripe for mouse support, but it won't support the pointing de-

vice until a future release.

In general, *4c's* operation is elegantly simple. Using *Briefie* (runtime module provided), the database is quite speedy. If you need to make order out of C pro-

gramming chaos, try *4c*.

List Price: *4c*, \$89.

Requires: 512K RAM, DOS 2.0 or later. Not copy protected. Tri-Technology Systems, 1225 S. Elgin, Forest Park, IL 60130; (312) 366-7595.

CIRCLE 436 ON READER SERVICE CARD

\$100 Neural Network

PC HANDS ON

BY BARRY SIMON

BrainMaker from California Scientific Software is one of several recently released programs that let you build your own neural networks. The \$99.95 program is an intriguing tool for exploring neural nets.

Neural networks represent the opposite end of the artificial intelligence spectrum from rule-based expert systems. Rather than formulating a set of well-defined rules based on intelligent analysis, neural networks involve forming interconnections in a system based on feedback training. Once the connections are right for the trial set,

the system has an uncanny knack of giving good answers for nearby inputs.

With *BrainMaker*, you choose the representation of input and output as patterns, numbers, or symbols. You also choose the number of neurons in the input and output layers and one or two hidden layers. *BrainMaker* also allows you to adjust some more-technical parameters. As you run a set of trials through the network, the connections between the neurons are adjusted via a simple feedback mechanism until the trials are right. A number of sample network-definition files, which you can see train, are included.

BrainMaker comes with a slick drop-down menu, a

mouse-driven interface, and two thick manuals—one for the program and one on neural networks in general. It is an ideal tool for those interested in learning about this technology.

Other new arrivals in the neural network arena include *The Brain Simulator* (\$99) from San Francisco-based Abbot, Foster & Hauserman, and *NeuroShell* (\$195) from Fredrick, Maryland-based Ward System Group.

List Price: *BrainMaker*, \$99.95. **Requires:** 512K RAM, mouse highly recommended, math coprocessor used if found, DOS 3.0 or later. Not copy protected. California Scientific Software, 160 E. Montecito Ave., #E, Sierra Madre, CA, 91024; (818) 355-1094.

CIRCLE 437 ON READER SERVICE CARD

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It can happen with no warning. The sky goes dark and then it's there. A whirling funnel that destroys everything in its path, leaving little or nothing that can be retrieved. Just the way that disaster can strike your hard disk, scattering your data to the wind.

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PC UPDATE

edited by Paula Seefeldt

**CADvance
Goes 3-D**

CADvance, from ISICAD, now offers true 3-D capabilities. Providing a visual reference while the user draws, the 3-D Visual Guidance System incorporates a 3-D reference grid, a working plane, and a 3-D cursor. Version 3.0 also has an improved link to dBASE and better mechanical and engineering functionality. Upgrades are free to users who purchased the current version after October 17, 1988, and \$395 to all other users. List price is \$2,995. ISICAD Inc., Anaheim, Calif.: (714) 533-8910.

**Opus Cuts
Prices**

Opus Systems has implemented price reductions on its coprocessor products as a result of lower DRAM prices. The RAM-adder charge for **Opus Systems Series 220, 340, and 350** personal mainframes has been reduced by 26 percent, from \$175 per megabyte to \$130 per megabyte. Opus Systems, Cupertino, Calif.: (408) 466-2110.

**Signal Works
With
DESQview**

Signal, the financial information service from Lotus Information Network Corp., is now compatible with **DESQview**, Version 2.2. In addition, **Signal**, Version 2.1, gives expanded data to futures and options traders and provides a feature that enables traders to change expiration dates in their portfolios. Upgrades are available for \$55. **Signal**, Version 2.1, retails for \$595. Lotus Information Network Corp., San Mateo, Calif.: (800) 367-4670.

**Topaz
Provides
Database**

The Research Group has released **Topaz Toolkit**, a database and programming tool kit for Turbo Pascal 4.0 and 5.0. **Topaz** creates a programming environment in Turbo Pascal with



Topaz Toolkit transfers files into Turbo Pascal.

data entry and screen features, such as multi-field editing and unlimited data input validation. **Topaz** also provides data storage with full read/write access for ten open dBASE database files. **Topaz Toolkit** retails for \$49.95. The Research Group, Brisbane, Calif.: (800) 468-9273.

**Windows
Express:
Customizing
Options**

Windows Express, the graphical menu system from hDC Computer Corp., has increased its number of display preferences and customizing options, including personalized library options. **Windows Express** also runs applications that directly modify memory and has more



Windows Express now offers a larger display menu.

speed than hDC's previous menu system, **ClickStart**. Upgrades from **ClickStart** are free to those who purchased the product after June 1, 1988, and \$20 to those who purchased prior to that date. The new product, **Windows Express**, Version 2.1, retails for \$79.95. hDC Computer Corp., Redmond, Wash.: (206) 885-5550.

**Mirror III Adds
Language**

SoftKlone has added a new data communications programming language to **Mirror III**, its data communications package. PRISM (Programmable Integrated Scripts for Mirror) enables users to design user interfaces and script application and process data from remote sites. **Mirror III** also provides a Dialing Directory, CompuServe-B protocol, and a file compression/verification feature. **Mirror III** retails for \$99.95 and comes complete with a 60-day money-back guarantee. Upgrades are available for \$29.95. SoftKlone, Tallahassee, Fla.: (904) 878-8564.

**ModelMate
Plus Adds
Primitives**

Control Automation is shipping a new release of **ModelMate**, its 3-D modeling software. **ModelMate Plus** supplies additional primitives and Boolean operations to enable users to create models with constructive solid geometry methods. In addition, the updated version provides dithered light source shading for low-end graphics cards. Two new option modules are also being released with the software: **MPROP** allows users to analyze models and determine properties, and **MPRINT** supports extended memory and virtual screen printing. **ModelMate Plus** retails for \$1,495. **MPROP** is available for \$249 and **MPRINT** for \$149. Control Automation Inc., Altamonte Springs, Fla.: (407) 682-7077.

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Edited By Bill Howard

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—New York Daily News, November 1, 1988 (item reprinted in full)



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—PC Week, June 28, 1988

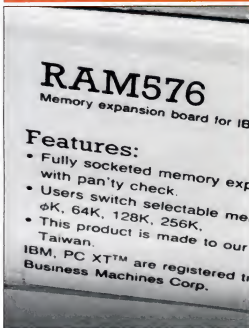
Amazing Facts

"The [new Macintosh] machine will feature an 80-megabyte drive, compared with the 40-megabyte drive of the current Macintosh II, analysts predicted. Thus the new model will double the Mac's processing power to 80 million pieces of data per second."

—Reuters news service story, Investor's Daily, September 13, 1988

Image Scanner for \$299 Is Among Inexpensive Products Out Recently

Rule No. 1 for scanner buyers: Know when you need the wide-corrage version.
Headline in The Washington Post, May 23, 1988.



Features label on a box containing a Sanyo Information Systems RAM576 memory board. No wonder novices have trouble telling hardware from software.

Hello? Hello?

The Rupp Brothers' Fastwire II license agreement tells users, "You (the buyer) may use the program on a single machine."

Fastwire II is a PC-to-PC file transfer utility that works only by installing the program on two machines.

"The winners in publishing systems will be those whose software can be easily ported to different computers. At the low end that means word processing programs like Xerox' Ventura Publisher..."

—Forbes, October 31, 1988

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"The VAX Grammar Checker, billed as the world's first software to correct documents that analyzes sentence structure, will spot those embarrassing little flaws that make you wince when you re-read old business correspondence. You know, the mistakes that wind up tacked to the bulletin board and circled in red, or highlighted in the company newsletter."

—Philadelphia Daily News, July 29, 1988

Have you seen anything offbeat or unusual about the computer industry? Send submissions to *Communique*, PC Magazine, One Park Avenue, New York, NY 10016. Please print your name legibly and include your T-shirt size. Contributors receive \$50 and a PC Magazine T-shirt.

Winners for this issue: Ed Ferratore (PM shops), Yole Jay Lublin (scanner), Clay Harris (pan'ty check), Stephen Moss (23,000 feet over Europe), Bryn Kaufman (Ventura), Charles Stahlecker (grammar checker), David Klein (Fastwire II), Tom Barkume (Macintosh).



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■ BILL MACHRONE

POCKET COMPUTER PROGRESS REPORT



Sharp's new Wizard qualifies as a true pocket computer. The key to its success, however, is not its diminutive size, but a companion program you run on your PC.

Sharp just barely avoided a disaster with its latest wonder, the Wizard OZ-7000. In a nutshell, it's the first practical pocket computer, no larger than your Day-Timer. It offers the usual calendar, alarms, scheduler, to-do list, world clock, and notepad. Two things separate it from the Casio and other, lesser electronic organizers: application cartridges and a serial port.

The cartridge slot is important since it makes the machine expandable, both in memory and function, but the serial port is critical. With it, the Wizard becomes wise. Without it, it's just another clever toy. Yet Sharp almost left it out.

Mark Eppley, the ebullient owner of Traveling Software, is the author of *Lap-Link*, *Battery Watch*, and half a dozen other handy products that no on-the-go computer user can afford to be without. Sharp approached Eppley to write its expense manager plug-in module and to do a Wizard-specific version of *Lap-Link*. Eppley, an enthusiastic proponent of portable computers (he wrote *Expense Manager*, one of the first applications for the Radio Shack Model 100), jumped at the opportunity. His resulting program, *Wizard Link*, makes the Wizard useful.

HARDWARE AS SOFTWARE In order to evaluate any software product properly, you have to give yourself over to it, immerse yourself in it. Otherwise you come hard up against your own prejudices.

The Wizard, although it looks like hardware, is actually software. The essence of hardware is that it's programmable; the

Wizard isn't. It's a self-contained set of integrated application programs with a hard-wired user interface. The myriad buttons are actually icons, working just as they would on a Mac, calling up applications or modifying their functions. The screen, at 8 lines by 16 characters, is actually sufficient for the Wizard's intended role.

The Wizard is a very good calculator, a better-than-average telephone directory, a perfectly terrible notebook, and a superb scheduler/calendar. With the addition of the Time Expense Manager card, it becomes a very good way to manage your expenses—if you hook it up to a PC.

TYPING BLIND The Wizard's biggest and most obvious fault is its keyboard. The keys are laid out ABCD-style instead of QWERTY. They might as well be laid out randomly for all the good it does when you try to enter anything. The ABCD layout reduces everyone to the same common de-

nominator—helpless hunting and pecking. Of course, a QWERTY layout wouldn't fit the Wizard's vertical orientation. Sharp's product people based the layout on focus group research that said businesspeople want their electronic doodads to open vertically, not horizontally. I think they asked the wrong people the wrong questions. Of course, you wouldn't be able to touch-type on a QWERTY keyboard that size, but at least your fingers would know where the letters are relative to one another.

Fortunately, the Wizard's software is geared to minimize typing. The Time Expense Manager, especially, is extensively table driven. You set up your expense categories the way you want them, or use the defaults. Methods of payment are in another table, also customizable.

You can load the Wizard's personal dictionary with common places of travel, client names, even favorite restaurants. These items can become part of the expense record with as few as two keystrokes in lieu of the tedious pecking from the keyboard. The user dictionary also enforces consistency in your responses. In addition, the Time Expense Manager sports a to-do list, time accounting, an hourly billing feature, and a decent little report generator that summarizes expenses, projects, and time in a number of useful ways. If you upload through *Wizard Link*, it'll convert the Time Expense Manager records into a .WKS file for you.

REALLY HELPFUL One of the Wizard's most useful features is its superb calendar and scheduler. With *Wizard Link*,



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- Prints checks and W-2s.

HARDWARE REQUIREMENTS

IBM PC* or compatible. **HARD DISK REQUIRED.**

VIEWPOINTS

■ BILL MACHRONE

you can download your schedule and the Wizard will remind you of appointments, display a weekly agenda, and even show a Gantt-like chart of meetings throughout the day so you can easily spot open time slots and conflicts.

Here again, *Wizard Link* saves the day. At the recent Comdex in Las Vegas, my appointment calendar was a back-to-back nightmare. I would have worn through the pages of my usual pocket calendar with all the erasures and changes. Instead, I fired up *Wizard Link*, selected the Schedule application, put it in create mode, and typed in every appointment, event, and activity I wanted to attend. *Wizard Link* presented a handy prompt window in which to enter them. In seconds I zapped a week's worth of chaos across the line to the Wizard and headed for the plane. Then, at my leisure, I reviewed the week through the Wizard's daily calendar mode. Suddenly it didn't look so chaotic. I eliminated a few items that I knew I wouldn't make, set alarms on a few that I had to make, and even set my wake-up times on a day-by-day basis. Boy, did I feel smug.

TEACHING A LESSON You can get *Wizard Link* from Sharp or from Traveling Software. Sharp's connecting cable is an unbelievable kludge that belies the sleekness and miniaturization of the Wizard. It's a big tin box with wires coming out of it and an external power cord. On the other hand, Traveling Software has built all the electronics into one end of the cable and takes its power from the PC's serial port, just as *Lap-Link* does. Could the Japanese learn something about miniaturization from the Americans? The software, in either case, is identical.

Is the Wizard a real productivity tool or an executive toy? It's the lead product in the Sharper Image catalog, the ancestral home of executive toys. Sharp has advertised it in newspapers around the country and is continuing a major media blitz to make everyone aware of the Wizard.

Sharp believes in the Wizard from a consumer standpoint. Mark Eppley believes in the Wizard because it extends the reach and utility of your PC. I believe in the Wizard because it's a solution to a big problem. It's not the best solution or the only solution, but it's a great start. ☐

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THE END OF THE COMPUTER DEALER



The computer store of today is a cold and heartless place, peopled by obnoxious sales types who know a little about computers and a lot about sales.

A July 1988 market research study conducted by Techtel Inc., a California-based research firm, indicates that nearly half of the respondents who had an opinion about computer stores had a negative opinion. ComputerLand, Businessland, MicroAge, and Entré were all cited. As a control (and possibly as a joke) Apple prexy John Sculley and yours truly, John C. Dvorak, were included in the study. Both of us got higher opinion ratings than any of the stores.

I've been fascinated by the computer store phenomenon since it began as a series of funky Byte Shops back in the 1970s. Run by people who knew little about retailing but plenty about computers, they made money without effort. Many of these guys had to make mistake after mistake to finally lose money. Eventually, they died off, only to be replaced by today's retailer.

MUTANT STORES The change is depressing. Over the years the stores have mutated from comfortable places where one could see and play with computers and software into slick, almost slimy, polished facades peopled by fast-talking salesmen or asocial nerds wearing bow ties. The negative store image is a direct result of the aseptic controlled and uncomfortable atmosphere found in the majority of today's computer stores. These stores are professionally designed, I might add.

Fact: It's difficult to walk into a computer store and actually enjoy the experience. The stores are cold, heartless, depressing. The idea seems to be to keep you from exploring—to keep you from straying.

Heaven forbid you should touch a computer and learn something. Whatever you do, don't handle the software.

The notion that the customer should remain uneducated is epitomized by the stores' eschewing computer magazine sales for no other reason than that computer magazines advertise competitive, low-priced mail-order software. You'd never know computer magazines even existed when you go into some of these places. In the old Byte Shops, magazines were everywhere. How endearing is a dealer who keeps the customer in the dark about everything? The irony of the notion that magazines threaten the stores' sales of lucrative software is that few dealers carry much of the software anyway.

The magnitude of this dealer image problem dawned on me recently when I walked into a new computer store that is part of a chain appealing to Macintosh users. You'd think this would be a cool and

loose crowd. Hardly. It was a typically creepy and oppressive slick layout with carefully arranged workstations and sales stations and software stations. The floor was carpeted and so was the bald owner. The salesperson was a Mac geek who had the personality of a herring.

MULTILEVEL GEEKS This Mac haven was as out of place as imaginable, but he dressed in a coat and tie and did what he had to do to keep his job so he could buy stuff wholesale. If he annoyed you, then you were confronted with the next level of geek; the used car salesman. Go up another level and you had the car lot owner. All I noticed was that these stores and these bosoz don't encourage browsing. I left and vowed never to return to the place. It sickened me. According to the study cited above, I'm obviously not alone.

It's apparent that computer stores are hurting the business and are largely responsible for their declining reputations. IBM is part of the problem. It validated the superslick approach with the now-defunct IBM retail stores. You couldn't find anyone in those stores who even knew what "DOS" stood for. The legions of me-too sheep saw this and copied the notion. They recruited obnoxious salespersons (salesmen?) who knew a little about computers and too much about sales. Maybe if they hired a few females who knew how to say hi without a sneer, sales would soar.

Then again, maybe all it takes is to turn the stores back into the comfortable places where you felt welcome. Don't hold your breath.



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■ JOHN C. DVORAK

INSIDE TRACK

A final look at Comdex's tenth anniversary show.

It's not that last November's tenth anniversary edition of Comdex was a bust. I enjoyed the show. It's just that there was no theme and no focus and nothing really happened. In fact, the show has become what Comdex has always wanted it to be: a Computer Dealers Exposition, COM-D-EX. It has matured. As such, it was about as exciting as a furniture dealers' show or pet shop accessories convention.

Dealers and vendors did well talking to each other about their new boxes and new logos and elaborate promotion plans. But was anyone looking for exciting new products? Naw! Except for three or four new products (out of thousands exhibited) there wasn't much to see. I wonder whether the few hot items were worth the journey.

Here are the top four hot products. The first great product I saw was the flat panel full-color 640 by 200 active-matrix LCD from Hitachi. This 6½-inch CGA display was breathtaking, albeit small. This looks like no LCD you've ever seen. **It's a killer.** An engineer manning the booth said that Hitachi is working on a 10-inch version and another 6½-inch prototype that has 640 by 400 resolution. To me, this was the highlight of the show and the true direction of display technology. It looked like a tube display. Stunning.

Meanwhile, in the Panasonic booth I discovered the second and third great products of the show. First was a disk drive that was the size of a cough-dropper box. It utilized the new Matsushita (a.k.a. Panasonic) 2-inch floppy. Unlike the unusable Sony analog 2-inch found in cameras, this "real" 800K floppy disk is compatible with 3½-inch and 5¼-inch controllers. This is what we're looking for and what Zenith decided to use on

its new super-lightweight portable. Matsushita is the heir apparent to the floppy disk of the future. It was Matsushita that made the joint venture with Shugart during the heyday of the 8-inch drives a decade ago. Most of the technology was transferred to Matsushita, where it was improved to the point where most engineers feel this company now makes the best disk drives available. I expect this drive to become a standard.

Also buried in the Panasonic booth was a Matsushita 3½-inch drive capable of storing over 16MB (11MB formatted). I liked this drive because, unlike other such drives, it has its own servo motor that can be used by the drive to write the necessary servo tracks on the disk. These high-density floppies all require servo tracks and until now the user had to buy overpriced preformatted disks to make them work. Not so with this beauty. But, like other super-high-density drives, it requires expensive metal-particle diskettes.

Elsewhere around the show there were other high-density drives, things called flopticaldisk drives, even a green-gel-coated worm disk. The ubiquitous Leland Strange even had a 3½-inch drive that he claimed stored over 40MB. Few, if any, of these designs will be accepted. I'm sticking to the Matsushita designs. They're beautiful and the company has the market status to easily make them standards. This is not the case with all the other oddball drives that were shown.

The fourth hot item was a little device called the Private Eye from Reflection Technology in Cambridge, Massachusetts. Employing a proprietary plasma, this display is worn like a monocle over one eye. The device looks like a black film can that you peer into. A Hercules-

caliber high-resolution (actually 720 by 280) monochrome image is clearly visible "floating" in air. Expected to cost \$100 or so in OEM quantities, this device will make practical the subminiature, cigarette-pack-sized portable computer in the years ahead. Ray Kurzweil and a group from the MIT Media Lab are the money and brains behind this thing.

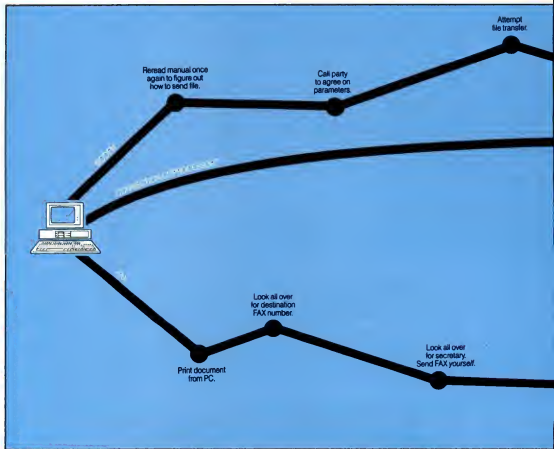
Back to the show. This year's Comdex was even more spread out than in years past. Luckily, there seems to be some attempt to stop the disorganized nature of the event. The promoters intend to start MacDex, a concurrent show specifically aimed at the Macintosh market. The Mac vendors were up in arms about being split off. Fact is, this is a good idea. Comdex actually needs to be sectioned into more-severe partitions. I think software, peripherals, hardware, and furniture are perfect examples of "segments." The problem is that many vendors have a reserved spot in the middle of the main hall and don't want to end up in some back room of the Sahara. MacDex is at least a step in the right direction.

Reorganization notwithstanding, there was still the coy Taiwanese fellow standing outside the main hall holding a big sign. It read: "Need DRAMS? We have them!" I loved it.

If anything was missing from the show, it was that inexplicable nervous vitality one perceived in years past. Unlike before, there wasn't the worry about the recession or the incessant hand-wringing over the demise of the industry or of IBM's taking over everything. It was a "What? Me, Worry?" kind of show. That idiotic tune "Don't Worry, Be Happy," was played everywhere.

Last year people fretted. This year they relaxed. I never saw so many people carrying tennis rackets on board the planes before. It was like Leisure World. I never saw so many optimists. I had to conclude one thing: something terrible is about to happen.

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But Symphony is really more than five separate programs. Because, unlike other integrated packages, Symphony lets you dynamically integrate functions. For example, when you change spreadsheet data, your graph of that data and your memo containing the same

numbers automatically reflect the changes. So you get greater efficiency, and you're able to work faster too.

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We could go on about the many features of Symphony 2.0—how its macros let you automate complex or repetitive tasks and create customized applications. How the word processor now has a spelling checker and text outliner. And how database and communications have been improved.

The bottom line is that Symphony is one high performance package that's made to be opened up.



Lotus Symphony 2.0

■ JIM SEYMOUR

MOUSING AROUND WITH LOTUS



A devoted fan of alternate input devices has long despaired of getting a mouse to work well with 1-2-3. Now he's found a solution to this difficulty.

I'm a big fan of that category of peripherals known in the trade as "alternate input devices." I use a digitizing tablet regularly, I really like trackballs (I even hope to find a decent one for PCs someday), and my collection of mice could fill a drawer.

It's not that I have anything against keyboards. But for much of what we do on computers—from navigating around the screen to entering something other than letters and numbers—keyboards are exceedingly blunt tools. So I continue to search through the desert of PC alternate input devices, looking for that fabled Better Way.

While they're not perfect, I'm convinced mice are our best bet. From Doug Englebart's very early hand-carved wooden models through Pierluigi Zappacosta's early gray plastic lumps to Logitech's sleek C7s to today's champ, the Bauhaus Maus from Microsoft, computer mice offer the right kind of hand-eye link to what we see on-screen.

That conviction has sent me down some enticing but eventually unrewarding paths. A recent walk on the wild side was with Felix, a good idea that fails on execution. Felix consists of a stubby control stick that you move back and forth in a horizontal plane, all encased within a small, fixed box on your desk. It's a cross between a trackball—the base stays still while you move something within that defined boundary—and a joystick. The ballistics of the cursor movements that result from manipulating Felix's little thingamabob are good, but as you move its little plug

back and forth with your thumb and forefinger, you realize how much it needs better viscous damping, for smoother movement.

Actually, what really caught my attention about Felix wasn't its odd shape and construction but the software that comes with it. For the first time, I was confronted with new ideas about how to use a mouse with 1-2-3.

THE TROUBLE WITH MICE I've become convinced that the real problem with mice devices is that they're poorly integrated with application software. Using a Macintosh forced me to that conclusion; while the Mac has had terrible mice, the level of integration between the mouse and the software is so high that you soon forget that unfortunate thing in your hand and relate strictly to what's happening on-screen.

In the end, as much as I truly like mice, I use them on PCs only with *Microsoft Win-*

dows and with one other application program. (*Windows* so demands a mouse that to use its keystroke alternatives is sheer madness.)

Felix's software did a good job of increasing the power of the 1-2-3 user, in effect replacing Lotus's set of paradigms for moving around the spreadsheet with another set (Felix's). But in the end, that was exactly what I *didn't* like about it.

KEEPING THE FEEL I want a mouse-driven program to behave the same way it would when run from the keyboard. The other program I use on the PC with a mouse is *Microsoft Word*, which uses the alternate input device to expedite the text-editing process, never departing from but accelerating the approach used when you run the program exclusively from the keyboard.

A program such as 1-2-3 has an idiosyncratic (and for many of us, deeply ingrained) scheme of doing things, and I want a mouse-control program that expands on rather than replaces that scheme. Put more simply, 1-2-3 run by Felix just didn't *feel* much like 1-2-3 anymore.

So I went back to using a mouse with *Microsoft Excel* (and noticed how much I liked that), while using 1-2-3 strictly from the keyboard. And I noticed how much I didn't like that.

Then, a couple of months ago, I came across Marq Technologies' little 1-2-3 mouse-control utility, *MarqNavigator*. With the cynicism of the world-weary, I put it on the desk, booted up 1-2-3—and fell in love.



■ JIM SEYMOUR

SOMETHING REMARKABLE Look, even if you don't like mice, and maybe if you don't even use *I-2-3* on a regular basis, you've still got to see what this wonder can do. It dramatically speeds and eases

using *I-2-3* while keeping the Lotus look and feel.

MarqNavigator wraps the blue Lotus border all around the screen and drops the *I-2-3* function-key assignments into the

right border. The usual *I-2-3* commands appear in their familiar positions across the top of the screen. Just roll the cursor over one of those familiar Lotus top-of-the-screen commands and a drop-down menu appears. Keep moving till the cursor is over the command you want, click the left mouse button, and you've executed the command. To use function-key commands, just click on the function-key hot spots on the right side of the screen.

One of the glories of *MarqNavigator* is the incredibly fast, smooth navigation it offers when you move around a large worksheet. Using *MarqNavigator* gives you an incredible feeling of speed and fluidity as you work with *I-2-3*. I invited a handful of coworkers who also rely on *I-2-3* to use my machine for a while to see what they thought of it. Without exception, their reactions were like mine—and more than one used the word *fluid* to describe the feeling you get as you swoop around the worksheet.

■ One of the glories of *MarqNavigator* is the incredibly fast, smooth navigation it offers when you move around a large *I-2-3* worksheet.

I don't often get this excited about a utility program. Indeed, I held off writing about it for a month, to see if that first blush of enthusiasm would fade. It hasn't.

You can reach Marq Technologies at (800) 336-8366. *MarqNavigator* lists for \$149 and supports the Logitech and Microsoft mice.

If you're half as interested in mice as I am, you really owe it to yourself to have a look at *MarqNavigator*. Even if you're a crusty "real men don't use mice" type, take a look.

Fair warning, though, for the determined curmudgeon: it'll change your mind.



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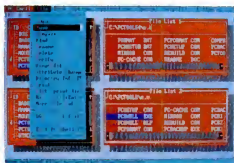
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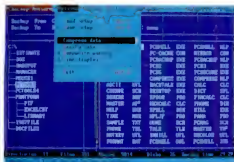
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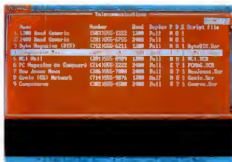
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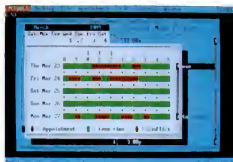
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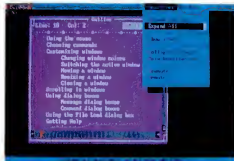
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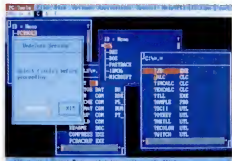
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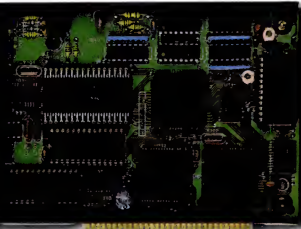
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■ WILLIAM F. ZACHMANN

OS/2—READY TO TAKE OFF



For some time, OS/2 has been an operating system without a purpose. But at last, the hitherto unrealized promise of OS/2 is becoming a reality.

Even though IBM and Microsoft managed (just) to meet IBM's promised October 1988 delivery date for OS/2 Standard Edition 1.1, that product so far has been of little practical value. The primary problem is that IBM met its self-proclaimed shipment deadline with a product that wasn't quite ready for prime time.

In fact, it wasn't ready at all. The real miracle was that the joint IBM and Microsoft development team was even able to deliver the product. Although the development groups headed by Steve Ballmer at Microsoft and Dick Hanrahan at IBM did a tremendous job, the delivered product was missing some critical pieces.

Specifically, IBM OS/2 SE 1.1 was shipped with but a single output device driver (PRINTER1.SYS) supporting the basic IBM 4201 Proprinter. To put it mildly, 9-pin dot matrix printer output of Presentation Manager graphics (through a single IBM printer model) isn't good for much. In fact, an operating system that cannot produce output with non-IBM printers isn't really good for anything at all. That is exactly the kind of system OS/2 SE 1.1 has been so far.

The second problem is that applications using the Presentation Manager, while slightly more numerous than hens' teeth, haven't been falling off the shelves of software stores, either. Not only did the number of OS/2 applications fall far short of the 1,000 that, in early 1988, IBM had claimed would be available by year's end, but none of them made any use of the Presentation Manager.

All of that is finally starting to change. IBM's OS/2 "Device Support Supplement" diskette, promised for February 28, will at least provide drivers for the most widely used IBM printers and plotters. Drivers for third-party printers are beginning to appear and will soon be generally available. Other personal computer vendors are starting to deliver OS/2 Standard Edition 1.1. And, even more important, software that truly makes use of the Presentation Manager is starting to ship.

READY FOR SPRING FLOODS? April 2, 1989, will mark the second anniversary of the announcement of OS/2. By that time, the promise of 2 years ago (at least as far as OS/2 is concerned) will finally be matched by a corresponding reality. By Spring Comdex in Chicago—April 10 through 13—there will no longer be any doubt that OS/2 is on its way. By then, the trickle of Presentation Manager applica-

tions will have become a flood!

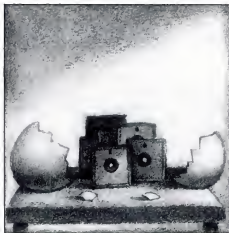
As has already become obvious, however, the adoption of OS/2 and the Presentation Manager does not mean we will see a radically different set of application software. Word processing and spreadsheets, followed by communications and database management, are still going to be the most widely used applications on personal computers running OS/2 with the Presentation Manager.

Artificial intelligence, expert systems, personal information managers, "groupware," object-oriented programming, and all the rest of the hot topics writers like to write about and experts like to pontificate about, though useful and important in their own domains, won't overtake mainstream computer applications as a result of OS/2.

What's more, many of the applications appearing for "the real" OS/2 are already familiar to those who have been using the Apple Macintosh since 1984 (and the Lisa even before that), or *Microsoft Windows* as early as the end of 1985. The Graphical User Interface of the OS/2 SE 1.1 Presentation Manager does not offer capabilities that are dramatically different from those already found on the Mac or with *Windows*.

As a matter of fact, many of the new applications appearing for OS/2 have been adapted from the Mac or have already appeared as *Windows* applications. Others, even though first appearing under OS/2, are similar to applications found in the Mac and *Windows* graphics environments.

Nevertheless, it would be a mistake to dismiss the emerging OS/2 applications



■ WILLIAM F. ZACHMANN

(and OS/2 with them) as nothing new. While the differences between the environment of the OS/2 Presentation Manager and *Windows*, for example, are not dramatic, they are still significant.

NEW OPPORTUNITIES For many users, the differences certainly are great enough to justify the incremental costs of OS/2. For although OS/2's multitasking and access to a larger memory space don't

affect the look and feel of applications as much as the move to the Graphical User Interface in the Presentation Manager, they do offer opportunities that were not available with DOS. For instance, the elimination of overlay structures, the management of large data structures in memory, and the creation of background processing threads will result in significantly faster execution for many programs.

Moreover, OS/2's multitasking, combined with its capabilities for handling keyboard input, permit the creation of far more powerful versions of DOS terminate-and-stay-resident utilities. Since OS/2 provides an orderly environment for such programs, the numerous problems with conflicts among TSR programs under DOS can be eliminated.

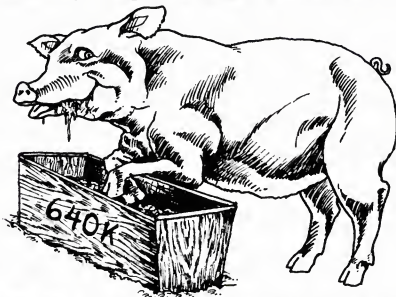
As software written for OS/2 matures, users will also be able to toggle among applications, exchange data among them, and gain access to far more powerful capabilities than were possible with DOS.

One of the biggest benefits of OS/2 will be in the handling of communications tasks in general and local-area-network connections in particular. All LAN and terminal drivers normally require a fairly large resident driver under DOS. This not only takes memory away from DOS applications but often causes problems with TSR programs as well. OS/2's multitasking and larger memory space eliminate these problems, making OS/2 a superior alternative for LAN-connected systems.

The greatest advantage of all, however, will be in the combination of the Graphical User Interface of OS/2 SE 1.1 Presentation Manager with the "across-the-network" interprocess communication capabilities made possible by the OS/2 LAN Manager. These provide more than just improved personal-productivity applications. They are the key to developing truly enterprise-wide, mission-critical systems designed around personal computers.

So while OS/2 won't drastically change what users do with PCs, it is important that we not underestimate its impact. Microsoft intended that OS/2 would be the office operating system for the 1990s and designed in the capabilities to do the job. As OS/2's promise becomes reality, the chances are very good that OS/2 will meet those expectations.

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Customer Profile

Regis McKenna

Age: Old enough to remember the day that Intel Corporation was founded.

Profession: Chairman of Regis McKenna Inc., a major marketing company based in "Silicon Valley." A general partner in the venture capital firm of Kleiner Perkins Coufield & Bayers. Author of the *Regis Touch* and most recently, *Who's Afraid of Big Blue?**

Hobbies: Enjoys doing extensive research on innovative new technologies. He recently became involved in building and archiving an extensive database, using state-of-the-art page recognition software.

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Deer Mr. Prodigy: I wood of cent this mess age over yore service, but you dont except Is this long. But let me remark write off the bat I think yore service is grate. It is every bit as enformative & innertaining as Bowling for 5 or the Weakly World Nooz & as satisfying as Old Milwaukee Light. Like they say, "It just don't get no better than this here."

I seen yore TV ads starring Linda Elerby of TV fame & Davy Joneson of hated NY Mets fame & some gy named Elvin Troffler I never seen b4 & then I stubbed upon yore empressif demon stration at the maul & I sined up then & their.

I did have some trouble with the in stallation part cuz it din't fine any disx called B or D on my sun's machine but after 2 or 3 cauls to yore tole free # yer people fixed me up & soon I was typing my id & puss word & after a littel weight for the WORK-ING sign to stop I was hooked to your Inter Active Personal Service & romed the bildings & floors, witch my sun what went to colledge calls metalfors.

NONSTOP ADS In the weaks to come I got to no that WORKING sign even better than all them great nonstop ads that show up in the little box at the bottom of the pitcher tube like this:

She'd love him forever. If only he'd let her. Lovelight series novels.

I just luv 'em! In fact, I will enclude some faves here witch I copied strate off the tube from time to time just like you do. But yore ads also let you push the Tab key to the box marked LOOK 4 fasinating info

such as the following:

Dupont's CORIAN is the aristocrat of surface materials.

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And, like a true aristocrat, CORIAN is only found in the best homes . . . like yours!

I new this was ment 4 me & so therefore orderd my FREE broshoor.

A MITE STRANGE I am specially empressed with yore stuff 4 kids. My dotter tys up the phone 4 hours wasting time with this which the Mrs. sez is better then TV she hopes. I was specially pleased to see that the Cycleopedeia Botanica Quiz splt Gibraltar just the whey I taut hur. & what she learnt from NOVA she rote down to lern by hart & show off at dinner:

Mites primarily eat, defecate, and copu-



late. A heap of fecal pellets, as many as there are stones in the Great Pyramid, could fit on the period at the end of this sentence.

I also lyked the way the ads for tax help & romance books & tires & home furnitings & such appeard wile my dotter was lerning such useful enformation. No sense hiding kids from the realties of life, sez I.

A fiberglass tub scrubbed with COMET sparkles WITHOUT a scratch on it!

There are meny fasinating stars you can read tips from & even rite to like H. Cosell & H. Eloise but hear I have a complaint. It sez "Send a message to Jane Fonda & get a perconel reply," witch I red rite after the Singles Colum witch sed:

Commitment is the buzzword of the '80s. And now sex without commitment is only for madmen. The only way out is to practice the skill of committing—and practice some more.

Sew I rote ole Jane I wanted to practice with hur, but she dint respond to my very personal preposition atall. Her mind must of been on other glands 4 her colum said

Thyroid disorders are not responsible for feeling cold, fatigue, or weight gain. However, if you suspect a thyroid disorder, consult your physician.

TOUGH AVOCADOS My college edgacated sun is 2 snooty 2 use Prodigy. He sez it takes longer to figger out how 2 order groceries with the service then to get in the car & get 'em & bee sides they probly stick you with the hard litle avocados the ones that never get so as you can eat em with out a sledge hammer & I am afraid the Mrs.

■ STEPHEN MANES

agrees so we aint tried it yet sorry.

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Sunny objex that you fokes only put 15
lines 40 caracters wyde on the screen at

one time not counting the ads & stuff, but
perconly that is OK with me my branc sells
get all confused wen sum body learns me
too much at one time. An other thing that
steerns him is that if yer fone gets messed

up, you get a dum massage & half to re-
boot yer machine. Sunny specially hates
the fact that when ever u are weighting for
a pitcher to change if u press any keys the
system just ignores 'em but I say what is
his smartypants hurry to beet the system.

*Is your upholstery as vibrant as it was 5
years ago? Maybe your windows are to
blame.*

Sunny sez if you really need 15 min. de-
laid stock quotes, you also need to be able
2 down load them to disx, which Progidy
cant do. He also ennoys that u cant print
out the Consommer Retorts on account of
the soft ware wont let you. But that is OK
by me cuz wen I try printing the pitcher
goes goofy & I half to reboot anyhow.

I dew agree with him on 1 point. I used
Easy Saber to find this grate fair \$158 r.t.
twixt NY & Seattle but I only sed restric-
tions apply & you half to call up to see
what they are, witch kind of defects the
porpoise. So when I call up I find out that
the restriction is that I half to be under 12 &
traveling with my parents. Sunny sez E. S.
on CompUSurf shows you that & whether
4 casts too, but I sez they don't show purty
pitchers like you do, so there.

As you can tell I am a fan. I luv yore bul-
letin boards ware people ax about food &
wine & have perconly recommended sum
of my very favorite gormay frozen dinners
& coolers and cant wate till Progidy is on
tap all over the country insted of just a few
burgs like mine. I luv the snappy tips of
"Dress 4 Success" Mulloy like:

*If you purchase a custom or made-to-
measure suit, insist on functional-button
cuffs. They are one of the hallmarks of cus-
tom tailoring.*

But I have a little bone to pick with that
Jeane Dixon horror scope. I am a Capri
Corn & she sed:

*Your chances of finding fame and for-
tune get a big boost this weekend. An act of
kindness will be richly rewarded. Recent
worries disappear. Extra cash accumu-
lates.*

I still got plenty of worries, but nun of
that there fame, fortune, reward, or cash
she promised. My sun sez I could get sum
of it by canceling Progidy and getting back
my \$9.95 no charge for connect time per
month but I say no way I am waiting for
Allen Bloom to get him a colum so I kin ax
him his sign perconly.

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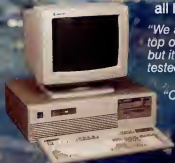
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1.2 Meg 5 1/4" Drive
1.44 Meg 3.5" Drive
40 Meg Hard Drive (28 MS)
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EVEREX EGA Board
14" EGA Monitor
1 Parallel / 2 Serial Ports
101 Key Keyboard
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25 Mhz 386 VGA

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Expandable to 8 Megs on MB
32 Bit Slot Open
1.2 Meg 5 1/4" Drive
1.44 Meg 3.5" Drive
80 Meg Hard Drive (28 MS)
1 to 1 Interleave
16 Bit VGA Board
NEC MULTI SYNCH II
1 Parallel / 2 Serial Ports
101 Key Keyboard
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80387 and Waitek Sockets
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20 Mhz 386 EGA

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1.2 Meg 5 1/4" Drive
1.44 Meg 3.5" Drive
80 Meg Hard Drive (28 MS)
1 to 1 Interleave
EVEREX EGA Board
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101 Key Keyboard
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Steve Apik & Stanford Diehl
Oct. 1988, EWTE
Review of 20 386

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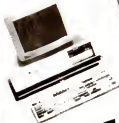
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**ALR FlexCache
25386DT**



\$9,517

"The ALR FlexCache 25386DT is a very...
relatively ev...

**Everex STEP
386/25**



\$20,213



**Comp
Deskpro**

"As in the past
produced one
machines in it

**Mic
ME**

\$7,122

Dell System 325

\$9,519



"The Dell System 325
pace with the best in te
... and the co

**IBM
Model**

EXPENSIVE, AND WORTH IT

The history of technology is the story of a constant effort to go past the existing superlatives—to explore farther into space, to plunge deeper in the oceans, to examine smaller particles of matter. And to build faster desktop PCs.

Microcomputers may not rank on the same level as space shuttles and particle accelerators, but then again the computer is a far more visible, more prevalent influence on the way most of us work. The MS-DOS micro market is our best hope of being able to own a piece of leading-edge technology, and today that means an

80386 machine running at the incredible rate of 25 MHz.

The reviews that follow take a hard look at the vanguard of this new performance standard. You will find that some issues are much the same as with any other class of PC-compatible computer, but you'll also find some surprising aspects to this class of machine.

WHOSE NEWS? Not so surprising is that these top-speed marvels command some of the top prices in the market. So the first question has to be, Who is buying

these lightning-fast machines?

There are a number of answers. As with any other development that breaks old limits and establishes new ones, there will be a number of people who must have a 25-MHz 386 simply because it is the latest. These pioneers are in the minority, since few of us have the resources to upgrade with every innovation that comes along. But many others will buy these machines for more substantial reasons.

And the basic reason is pure performance. These machines jump. Here you will find all the latest advances coming to

The collage features several overlapping advertisements for 386 PCs:

- Top Left:** Partial ad for a system with a monitor and keyboard, mentioning "S/2" and "70-A21".
- Bottom Left:** Partial ad for a "desktop saver" offering "premium performance" at a "premium price".
- Center:** Ad for the **Hertz 386/25**, featuring a quote: "Built on a motherboard and case package from Intel, the Hertz 386/25 uses quality components and solid construction backed by an... but its price is attractive alternative." The price is listed as **\$1,958**.
- Top Right:** Ad for the **Zeos 386-25/V** with a price of **\$9,308**.
- Bottom Right:** Ad for the **PC Brand 386/25** with a price of **\$5,995**, showing a monitor and keyboard.



25-MHz 386-based Computers: Summary of Features

(Products listed in ascending base-price order)

The following commentary analyzes some of the terms in this table of features. The phrases in bold type are listed in the same order as in the left-hand column of the table.

Basic configuration. Because hardware vendors frequently offer a choice among various hard disk drives and monitors—at different prices—we are reporting the price of a completely stripped-down model as a “basic” configuration. Note that these prices are not always strictly comparable because some vendors will not sell their computers without a hard disk. Therefore, when comparing products, please consult the “standard configuration” prices as well.

Software included. Hardware manufacturers may or may not bundle software with their computers. Bundled software may include DOS, setup and install programs, and various utilities. DOS is often available only at an additional cost. (Disk caching software appears under “memory specifications” near the end of the table.)

Reset switch. Many computers now come with a reset switch allowing a cold reboot of the computer. This switch saves wear and tear on the power switch.

Standard configuration. Purchasers will normally want a more elaborate system than our “basic” configuration. For the sake of price comparisons, our “standard” configuration includes 1MB RAM, a hard disk of at least 30MB, one floppy disk drive, a monochrome display, at least one parallel and one serial port, DOS, and a keyboard. The price of each system is followed by the size of its hard disk; total RAM is also indicated in cases where the package includes more than 1MB.

Tested configuration. The specifications (and list prices) of the evaluation units depend on what configuration each manufacturer has decided to send us for testing. **Upgrades and additions to the basic configuration** summarizes the distinctive features of the models that were actually reviewed.

Bus clock speeds (MHz). Bus speed becomes more important as computers run at faster clock speeds. A computer's bus speed may actually be too fast for expansion cards, most of which operate at 8 or 10 MHz. Time-out periods, sometimes called wait states, are often used to slow down the bus.

BASIC CONFIGURATION		PC Brand 386-25	Micro Express ME 386-25	Deil System 325
List price		\$2,450	\$3,999	\$4,799
RAM		1MB	1MB	1MB
Floppy disk drives		One 1.2MB 5¼-inch or one 1.44MB 3½-inch	One 1.2MB 5¼-inch	One 1.2MB 5¼-inch or one 1.44MB 3½-inch
Hard disk drive		None	40MB	None
Drive bays		Five half-height	Five half-height	Five half-height
Software included		Setup, diagnostics, optimization	Diagnostics	Setup, diagnostics, utilities, DOS 3.3, GW-BASIC
OS/2 available		Optional (\$145)	Optional (\$290)	Optional (\$325)
Modem		None	None	None
Ports		One serial, one parallel	One serial, one parallel	Two serial, one parallel
Slots		Two 8-bit, four 16-bit, two 32-bit	One 8-bit, six 16-bit, one 32-bit	Two 8-bit, six 16-bit, one 32-bit
32-bit bus manufacturer		PC Brand	American Megatrends	Deil
Power supply (watts)		200	220	220
Reset switch		●	●	○
Keyboard cable length (inches)		112	128	108
STANDARD CONFIGURATION				
Price of monochrome system with 1MB RAM, hard disk, and DOS		\$2,990 (40MB)	\$4,239 (40MB)	\$7,319 (150MB)
Price of VGA system		\$3,500 (40MB)	\$4,823 (40MB)	\$7,319 (150MB)
TESTED CONFIGURATION				
List price		\$5,995	\$7,122	\$8,519
Upgrades and additions to the basic configuration		2MB RAM, 150MB hard disk, 84MB tape backup, 1.44MB 3½-inch and 1.2MB 5¼-inch disk drives, VGA, 80387 coprocessor, DOS 3.3	4MB RAM, 140MB hard disk, VGA, 80387 coprocessor, DOS 3.3	2MB RAM, 150MB hard disk, 150MB tape backup, 1.44MB 3½-inch and 1.2MB 5¼-inch disk drives, VGA
Microprocessor clock speeds		8/25 MHz	8/25 MHz	4/7/8/25 MHz
Wait states		0	0	0
Bus clock speeds		8/12.5 MHz	8/33 MHz	8 MHz

●—Editor's Choice ●—Yes ○—No N/A—Not applicable this product uses discrete logic

Intel 386 25	Zenith 386-25 V	Everex STEP 386 25	ALR FlexCache 253860T	Compaq Deskpro 386 25	IBM PS 2 Model 70-A21
5.785 MB	\$6,145 1 MB	\$6,399 1 MB	\$6,690 1 MB	\$8,299 1 MB	\$11,295 2 MB
One 1.2MB 5 1/4-inch	One 1.2MB 5 1/4-inch	One 1.2MB 5 1/4-inch	One 1.2MB 5 1/4-inch	One 1.2MB 5 1/4-inch	One 1.44MB 3 1/2-inch
One 120MB	One 120MB	None	66MB	60MB	120MB
Five half-height	Five half-height	Five half-height	Four half-height	Four half-height	Three half-height
Setup, diagnostics, Disk Manager	None	Diagnostics, DOS 3.3	Setup, diagnostics	Setup, diagnostics	Setup, diagnostics
Optional (\$350)	—	Optional (\$325)	—	Optional (\$325)	Optional (\$325)
One	None	None	None	None	None
Two serial, one parallel	One serial, one parallel	One serial, one parallel	One serial, one parallel	One serial, one parallel	Two serial, one parallel
One 8-bit, five 9-bit, two 32-bit	One 8-bit, six 16-bit, one 32-bit	One 8-bit, six 16-bit, one 32-bit	One 8-bit, six 16-bit, one 32-bit	Two 8-bit, five 16-bit, one 32-bit	One 16-bit, two 32-bit
Intel	American Megatrends	Everex	ALR	Compaq	IBM
30	230	200	220	192	132
12	●	●	○	○	○
12	114 (plus 9-foot extension)	72	138	114	129
\$3,457 (40MB, 2MB RAM)	\$5,419 (40MB)	\$7,222 (40MB)	\$6,856 (66MB)	\$8,674 (60MB)	\$11,720 (120MB, 2MB RAM)
7183 (40MB, 2MB RAM)	\$6,114 (40MB)	\$7,696 (40MB)	\$7,613 (66MB)	\$9,717 (60MB)	\$12,606 (120MB, 2MB RAM)
10,375 MB RAM, 300MB hard disk, 1.44MB 5 1/4-inch disk drive, VGA, 80387 coprocessor, DOS 3.3	\$9,308 157MB hard disk, VGA, 80387 coprocessor, DOS 3.3	\$14,291 4MB RAM, 160MB hard disk, EGA, 80387 coprocessor	\$9,517 2MB RAM, 120MB hard disk, VGA, DOS 3.3	\$20,213 3MB RAM, 300MB hard disk, 135MB tape backup, VGA, 80387 coprocessor, DOS 3.3	\$15,958 4MB RAM, VGA, 80387 coprocessor, DOS 4.0
25 MHz	8.25 MHz	8.12.5/25 MHz	8.25 MHz	25 MHz	25 MHz
0	0	0	0	0	0
10 MHz	8.33 MHz	4.16.6.33 MHz	8.33 MHz	8.33 MHz	Variable

(continues)

gether to create a synergistic whole that can change the way you view your favorite (and not-so-favorite) programs. These machines offer an 80386 processor operating at more than four times the speed of the original IBM AT, but that's only the start. System memory caches handle as much as 90 percent of memory calls with no wait states. In the video arena, 16-bit VGA adapters with video BIOS remapped to fast RAM make displays more responsive. And hard disks are appearing with response times around 15 milliseconds, and that's before you install caching software that can make disk operations from two to ten times faster.

What does this performance mean to you, the end user? If you've tried running *Microsoft Windows* applications on an 8-MHz AT, you may have grown impatient with response times. Desktop publishing programs are also power-hungry, performing thousands of calculations to define the layout for each page. Computer-aided design (CAD) and other calculation-intensive graphics programs are often painfully slow on older machines.

Even mundane applications such as accounting programs and database management programs can become slow as file sizes increase. How long do you currently have to wait to close a month's transactions in your general ledger, or to reindex your customer database? These types of applications can run like molasses in a multiuser environment—whether a LAN or an operating system that lets you use terminals attached to your PC.

The extra speed of a 25-MHz 386 goes a long way toward solving these problems. *Windows* applications and desktop publishing programs can now join the land of the living. CAD programs will be able to put your drawings on the screen in less time than ever before. Your database applications are more likely to end up waiting for you than the other way around. And you can expect better response times from file servers and multiuser installations.

Be aware, however, that these computers may appear only slightly faster than some 20-MHz machines. Depending on configuration and application, the 25-MHz models may at best be 10 to 25 percent faster than a typical 20-MHz 386. Many users will find the difference be-



25-MHz 386-based Computers: Summary of Features

(Products listed in ascending base-price order)

Disk controller manufacturer and type Several interfaces are used to control the way data is transferred from the hard disk to the computer. The most common disk interface standard is the ST-506/412, used in the IBM PC-XT and PC-AT. Two other common data transfer interfaces are SCSI (Small Computer System Interface) and ESDI (Enhanced Small Device Interface). Both SCSI and ESDI require special hard disk controllers and cannot run off existing PC-XT or PC-AT controllers.

Disk encoding techniques currently include RLL (Run Length Limited) and the older MFM (Modified Frequency Modulation) scheme. All data is encoded onto and read from your hard disk as a series of polarity-reversing bits representing ones and zeros. Nine such bits would be needed to store 12 bits of data in MFM format, and only six polarity changes are required with RLL format; thus, MFM takes more space than RLL but provides a more stable environment and is more commonly used. ST-506 technology, for instance, uses the MFM encoding scheme.

BIOS version and date The BIOS date is important to those planning to use 3½-inch disk drives. Early BIOS versions cannot handle this format.

Memory chip type In this context, Kb and Mb refer to kilobits and megabits, respectively.

Chip packaging Memory chips come in a variety of styles: DIPs, SIPs, and SIMMs. The Dual In-line Package (DIP) is the traditional buglike computer chip sprouting 8, 14, 24, or even 40 or more metal legs (evenly divided between right and left sides). Single In-line Packages (SIPs) are single-package arrays of computer chip logic assembled so that all connecting legs are in a straight line, like the teeth on a comb. Single In-line Memory Modules (SIMMs), on the other hand, are individual logic devices that are installed on their own small circuit board, creating a component module that can be plugged into a larger device. Their physical arrangement duplicates the integrated structure of a SIP but allows for the possibility of replacing an individual memory component if necessary.

RAM chips RAM chips come in two basic types: static and dynamic. Static RAM chips (SRAMs) are faster and more efficient but costlier. Dynamic RAM chips (DRAMs) cost less and are more common, but the trade-off is in slower processing and operation.

Interleaved memory CPU speed is usually faster than memory speed. Interleaved memory increases processing speed by splitting the memory into two or more portions. The CPU then sends information to a section at a time, allowing one section to process while another receives data.

Shadow RAM Shadow RAM is a technology that loads system BIOS or video BIOS directly into fast RAM on boot-up of the computer. The BIOS then operates much faster.

Disk cache software Some companies provide their own software to facilitate caching. Other computers can generally take advantage of the caching facility within some version of DOS.

TESTED CONFIGURATION	PC Brand 386/25	Micro Express ME 386-25	Dell System 325	Hertz 386/25	Zeos 386-25/V	Everex STEP 386/25
Disk controller manufacturer and type	OMTI (ESDI)	Data Technology Corp. (ESDI)	Western Digital (ESDI)	Western Digital (ESDI)	Western Digital (ESDI)	Western Digital (ESDI)
System drive capacity	Controller card handles two floppy and two hard disk drives	Controller card handles two floppy and two hard disk drives	Controller card handles two floppy and two hard disk drives	Controller card handles two floppy and two hard disk drives	Controller card handles two floppy and two hard disk drives	Controller card handles two floppy and two hard disk drives
BIOS version and date	AMI BIOS (April 1986)	AMI BIOS (September 1986)	Phoenix BIOS, Version 1.30A1 (January 1986)	Phoenix BIOS Plus, Version 1.10 (January 1986)	AMI BIOS (August 1986)	Everex BIOS (derived from AMI; October 1986)
System board manufacturer	PC Brand	American Megatrends	Dell	Intel	American Megatrends	Everex
386 chip set manufacturer	Chips and Technologies	N/A	Chips and Technologies	N/A	N/A	N/A
MEMORY SPECIFICATIONS						
Memory chip type	256Kb, 1Mb	256Kb, 1Mb, 4Mb	256Kb, 1Mb	256Kb, 1Mb	256Kb, 1Mb, 4Mb	1Mb
Chip packaging	DIP	DIP, SIMM	SIMM	SIMM	DIP, SIMM	SIMM
RAM chips	DRAM	DRAM, SRAM	DRAM, SRAM	DRAM, SRAM	DRAM, SRAM	DRAM, SRAM
Interleaved memory	●	○	●	●	○	○
Shadow RAM	●	●	●	●	●	●
Type of cache controller	None	Discrete logic	Intel 82385	Discrete logic	Discrete logic	Discrete logic
Disk cache software	●	○	●	●	○	●
Maximum RAM on motherboard	None	8MB	8MB	8MB	8MB	8MB
Maximum 32-bit slotted RAM	16MB	8MB	8MB	16MB	16MB	8MB
Maximum total system RAM	16MB	16MB	16MB	24MB	24MB	16MB
OTHER						
Warranty	3 years	1 year (90 days on hard disk)	1 year on-site service	1 year on-site service from Intel	1 year	1 year
FCC certification class	A	B	A	B	A	B

*** Editor's Choice ●—Yes ○—No N/A—Not applicable; this product uses discrete logic.

Maximum 32-bit elotted RAM There is currently no standard for 32-bit cards, and not many cards are available today. Many computer manufacturers, however, have designed their own 32-bit slots for memory expansion cards. 32-bit slots for memory cards are especially important in the era of OS/2, a memory-hungry operating system.

FCC certification class Two classes of FCC (Federal Communications Commission) approval may be given to computers. Class A and Class B. These classes concern levels of radio-frequency interference. With Class A approval, a computer may be operated in a business locale. The tougher Class B rating allows home use as well, where computers are likely to be placed near radios and television sets.

ALR FlexCache 25360T	Compaq Deskpro 386 2S	IBM PS/2 Model 70-A21
Western Digital (ESDI)	Compaq (ESDI)	IBM (ESDI)
Controller card handles two floppy and two hard disk drives	Controller card handles two floppy and two hard disk drives	Motherboard handles two floppy, one hard disk drive
Phoenix BIOS, Version 1.10 (September 1988)	Compaq BIOS, Revision K. 2 (May 1988)	IBM Advanced BIOS (April 1988)
ALR	Compaq	IBM
N/A	N/A	IBM
256Kb, 1Mb DIP	256Kb DIP	256Kb SIMM
DRAM, SRAM	DRAM, SRAM	DRAM, SRAM
<input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/>	<input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/>	<input type="checkbox"/> <input checked="" type="checkbox"/> <input checked="" type="checkbox"/>
ALR's Extended Emulation 82385	Intel 82385	Intel 82385
1MB 13MB 14MB	None 16MB 16MB	8MB 8MB 16MB
1 year	1 year	1 year
B	B	B

(ends)

between "fast" and "incredibly fast" too slight to justify the extra cost of going with the top machines.

A CLOSE RACE Assuming that you need the extra edge offered by a 25-MHz model, the question that naturally follows is, What differences can you expect to find among these machines?

You may be surprised by what you won't find, such as great differences in performance. All of these computers were at least three times faster than an 8-MHz AT on the PC Labs benchmark tests. On the Floating-Point Calculation test, for example, the range of results (with one exception) was from 4.0 to 4.4 times as fast as an 8-MHz AT.

In most cases, any differences among processor performance were more than offset by other factors. Some machines came with faster hard disks than others. Some came with faster video displays than others. As a result, the actual performance differences you'll encounter depend on the application you run and which hardware it's most dependent on.

THE GREEN FACTOR So if you can't tell these units apart by performance, what differences can you expect to find? The answer is one word: price. Comparing the lowest-priced basic unit with the most expensive tested configuration reveals an incredible range from \$2,450 to more than \$20,000—almost a tenfold difference in a field of only nine computers, all performing at essentially the same speed.

This unusual phenomenon is the result of a fascinating development in the PC-compatible market. Just as processors are revving up to higher speeds, the manufacturers have turned up the throttle on development cycles. No longer do the top brands such as IBM and Compaq enjoy 6 months to a year offering the latest technology without competition from others. Instead of having to wait months for the clones to appear, we now wait only weeks. And in future cycles, it's possible that large numbers of low-cost competitors could appear almost simultaneously with releases from the bigger players.

This wide price spread splits the PC-compatible market into at least three distinct segments, which end up offering the

buyer some clearly defined choices.

At the top in terms of both price and quality, you find the major brand names of the industry. Compaq and IBM offer well-designed and well-built equipment, with broad support for their products.

At the bottom of the price list are the bargain clones. These machines exhibit uneven design and construction: sometimes you'll find inspired technical embellishments or high-quality components, and sometimes you'll find evidence of cut corners and poor workmanship. Often examples of both good and bad appear in the same machine. But the bottom line is the bottom line; these manufacturers are out to produce the most machine for the least possible money in order to grab at least a small section of the market.

The wide spread between top and bottom has opened up room in the middle. This gap is filled with machines that aim to compete not just on price but on less-tangible features such as quality and support. Their midrange prices make them more attractive than the top-level products, but they also offer more security than some of the lesser-known mail-order brands. Buyers have more confidence in computers that have a significant presence in the market, are solidly built, and (perhaps most important of all) come with on-site service as part of the warranty. Not even the big companies make that a standard part of their systems.

If you choose to go for a 25-MHz 386, your choice will be affected directly by two opposing factors: your confidence in the manufacturer and the size of your budget. If you feel more comfortable with a brand name and have a substantial budget, then you will be drawn to the better-known choices. If your resources are limited and you're more of a risk taker, you will probably look at the lower end of the price scale. Most users will end up scanning the solid midrange, however, balancing the cost and confidence factors.

Development of new 25-MHz screamers is continuing at a brisk pace. In addition to the nine computers reviewed here, production machines from Omega, PC Designs, Proteus, and Systems Integration Associates, among others, were unavailable for testing.

And finally, hang on to your hats, be-

■ 25-MHz COMPUTERS

cause here we go again. At least one manufacturer has stopped in-house development of a 25-MHz 386 motherboard. Why? Because it expects the new 33-MHz chips to be in adequate supply by first quarter of 1989 and therefore has stopped the 25-MHz development project in favor of the faster design. We'll have to wait and see how significant this extra speed may be, and whether the manufacturers will be able to solve the increasingly complex engineering problems that result from the faster clock.

At least for the moment, these 25-MHz machines hold top honors in terms of speed and power. If you can't wait for something even faster (or if this level of performance is high enough), these nine candidates should satisfy your need for speed.

ADVANCED LOGIC RESEARCH INC.

ALR FlexCache 25386DT

There's no doubt about it: the ALR FlexCache 25386DT is fast, and it's priced right at the middle of the market for this class of machine. Its state-of-the-art performance makes it a choice candidate for today's computer, but it has a few minor flaws that might make you think twice before plunking down the \$9,517 it would cost for the configuration tested at PC Labs.

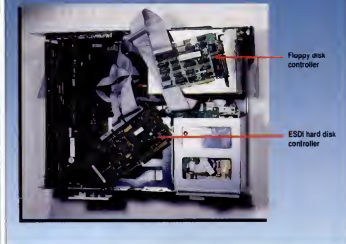
The FlexCache 25386DT produced benchmark-test figures that ranked near the top of the class in many of the processor tests. Much of the machine's speed stems from the ALR-designed motherboard, which includes a proprietary RAM cache that uses 64K of 25-nanosecond static RAM.

The hard disk provided with the 25386DT was rated at better than 28 milliseconds, but it was a bit slower than some of the disks that accompanied the other machines. The FlexCache was also relatively slow on some of the video tests; these figures were a little surprising because the 25386DT does use shadow RAM for video BIOS and came with a 16-bit VGA adapter. But since none of the performance differences were huge, most



ALR FlexCache 25386DT

The ALR FlexCache 25386DT is solidly built but suffers from somewhat cramped expansion potential. The VGA color system lists for \$7,613, which includes 1MB RAM and a 66MB hard disk. The case has only two half-height openings, and the separate ESDI hard disk controller and floppy disk controller take up two of the seven standard expansion slots where most competing designs would have only one slot filled.



people will find the 25386DT as fast as any other 25-MHz screamer for most applications.

The tested configuration had 1MB of 60-ns. RAM installed on the motherboard. According to company spokespeople, a new motherboard that can handle up to 4MB of RAM will be included in upcoming machines. Going beyond that requires a proprietary 32-bit expansion card. The evaluation machine had this card installed,

with an additional 1MB of 80-ns. memory; the card is designed to take up to three daughterboards sandwiched on top. These come in either 1MB or 4MB configurations, and the machine can handle up to 16MB of 32-bit memory.

There are seven other slots besides the 32-bit memory card slot: one 8-bit and six 16-bit. In the evaluation machine, three of these were filled with a 16-bit VGA card, a Western Digital ESDI controller, and an

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MINI FLOPPY DISK

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MINI FLOPPY DISK

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maxell
THE GOLD STANDARD

IS THE 82385 GOOD ENOUGH FOR 25 MHz?

The secret to getting top performance from a 25-MHz computer is memory caching. A small cache of expensive, high-speed static memory helps couple the fast microprocessor with slower and more affordable dynamic random access memory.

The issue of caching has only recently arisen in PCs because the 80386 is the first widely used microprocessor with the speed to outrun memory.

Intel Corp. provides a very powerful tool to aid computer designers in the quest for the perfect cache. The 82385 cache controller chip's extensive set of features serves as the cache's foundation. This one-chip solution has been adopted by several computer makers, including such familiar names as IBM (in the 25-MHz PS/2 Model 70-A21), Compaq, Dell, and Tandy.

Several makers of 25-MHz 80386-based products haven't adopted the 82385 solution, however, and some of them produce top performers. Both Advanced Logic Research and Everex use proprietary cache designs in their high-performance models.

The quest for ever-higher performance made these manufacturers look beyond the limitations of the 82385 to find unique solutions that would make their products stand out. The 82385 is designed to handle a 32K memory cache—a good compromise between cache cost and performance but not the ultimate in technology.

For some companies, particularly those in the shadow of the more established manufacturers, a performance increase of a few percentage points is exactly what they need to stand out. Consequently, ALR and Everex have opted for larger cache sizes that cannot be realized using the 82385 alone. ALR uses a 64K cache, and Everex uses a unique, scalable cache that consists of 64K to 256K, depending on the size of main memory.

Another reason these manufacturers have avoided the 82385 cache controller

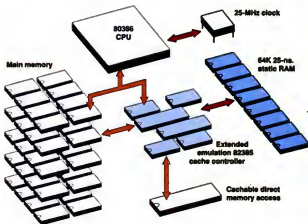
is development speed. Although Intel has tried to ensure that the speed ratings of the 80386 microprocessor and its support chips remain in step, the ratings of the 82385 have lagged slightly behind. When the ALR and Intel 25-MHz system boards were being developed, for instance, there was no assurance that 82385 chips with that speed rating would

be available in sufficient quantities to support quantity manufacture of the boards. Avoiding the 82385 ensured that its unavailability in the needed speed rating would not hinder system board production.—Winn L. Rosch

Winn L. Rosch is a contributing editor of PC Magazine.



ALR FlexCache Architecture: Upping the Ante in the 25-MHz Performance Wars



ALR's answer to the limitations of the Intel 82385 can be found in the ALR Extended Emulation 82385 cache controller and the size of its static RAM cache. Both the ALR and Intel controllers check for direct accesses of main memory that bypass the cache. When a direct memory access occurs, both controllers compare the contents of the cache with the contents of main memory. If the information being accessed is not in the cache, Intel's controller invalidates the corresponding flag in the cache, reloading the data if

and when it is requested again. The ALR controller, assuming that the data is already in the cache simply because it is needed, goes ahead and copies the altered data from main memory into cache memory, so that the information is ready when requested.

ALR uses 64K of high-speed static RAM, while Intel uses only 32K. Doubling static RAM improves performance by only a few percent, but in this war of speed, a few ticks of the clock can put you at the front of the pack.



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CIRCLE 224 ON READER SERVICE CARD

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ing the PC industry with a steady flow of advances in the state of the art, delivered at amazingly low prices.

ALR's heads-up engineering produced a proprietary caching system that gives the FlexCache 25386 top honors in virtually all of PC Magazine Labs Benchmark Series of tests. ALR also chose flexibility of packaging the 25386 in both an industrial strength tower cabinet and a sleek desktop configuration. The tower has enough drive slots to make any configuration LAN file server do its best and the desktop provides plenty of capacity for any standalone power user. For fast fileserving,

individual data crunching, or top-flight program development, the ALR FlexCache 25386 can't be beat.”

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Advanced Logic Research, Inc.

9401 Jeronimo, Irvine, CA 92718

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1-800-443-4CAN

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Winner of PC Magazine Technical Excellence Award 1988

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■ 25-MHz COMPUTERS



FACT FILE

ALR FlexCache 25386DT

Advanced Logic Research Inc.
9401 Jeronimo
Irvine, CA 92718
(800) 444-4257
(714) 581-6770

List Price: With 1MB RAM, 66MB hard disk, 1.2MB 5¼-inch floppy disk drive, \$6,690, with monochrome monitor, DOS 3.3, \$6,850; with VGA monitor, \$7,613; with 2MB RAM, 120MB hard disk, \$9,517; 150MB tape backup, \$1,890; 1.44MB 3½-inch floppy disk drive, \$225; 80387-20 math coprocessor, \$1,195; 80387-25 math coprocessor, \$1,395.

In Short: The ALR FlexCache 25386 DT is a well-built and relatively even performer, but its limited number of free expansion slots and open drive bays makes some competitively priced products more attractive.

CIRCLE 660 ON READER SERVICE CARD

ALR floppy disk controller including parallel and serial ports. That leaves only four open slots; you should be sure that will be enough for your applications if you are going to buy this machine.

CONSIDER THE CASE A more serious expansion limitation is inherent in the AT-like cabinet that houses the 25386DT. It has the standard power and disk access indicator lights and a system keylock but no hardware reset or processor speed switches. So far, so good; but then you notice that the case is so true to the original IBM design that it includes only two half-height drive bays that are open through the front of the case. In today's working environments, many people want or need at least three internal devices with removable media, such as a 5¼-inch floppy disk drive, a 3½-inch floppy disk drive, and a tape backup drive. With the 25386DT, you'll need to resort to external housings for any device after the second.

ALR does offer the FlexCache in an upright case version, which will accept a 3½-inch floppy disk drive as well as two half-height devices. It will also hold two full-height internal devices. This other version uses the same motherboard as the 25386DT; only the case and configurations differ. The tower version of a given

configuration costs about \$300 more.

In the end, the question is how much extra equipment you intend to plug into the 25386DT. As long as you don't expect to add too much in the way of drives or adapter cards, you should be more than happy with the overall performance of this machine.

COMPAQ COMPUTER CORP.

Compaq Deskpro 386/25

If the Texans down in Houston who design and build Compaq computers had a theme song, perhaps it would be "Don't Fence Me In." With the Deskpro 386/25, they have proved once again that they are willing to push the limits of 386 technology while pursuing their own ideas of what shape the technology should take.

When IBM let the world know that the next generation of desktop computers would have a new expansion bus, Compaq stuck to its six-shooters and the venerable AT-style bus. The manufacturer has a number of innovative new designs, including small-footprint and 386 machines. And this latest computer, which lists for \$20,213 in the configuration we tested, clearly wears the Compaq brand.

The Deskpro 386/25 has a number of features that set it apart from some of the competition. The most obvious is the high quality of its construction. Lots of metal is used throughout the machine, including the shielding around the disk bays and the cross brace that gives added strength to the left side of the case.

The disk drives are mounted on non-standard rails. While most machines use rails that are attached with two screws, the Compaq rails have three mounting holes.

Compaq has also used Torx-headed screws in its machines recently, and while these are more reliable and durable than standard hex-headed or slotted hardware, they can be a pain to work with if you don't have the correct-size Torx driver handy. The 386/25 uses Torx screws throughout, but on items that an end user might wish to remove, the screws are also slotted for a standard flat-blade screwdriver.

NO-MEMORY MOTHERBOARD The motherboard is Compaq's own design. It comes with a 25-MHz 80386 processor

and 32K of 25-nanosecond cache memory. Unlike most other designs, Compaq's does not allow for memory on the motherboard; all must go on a proprietary 32-bit expansion board. The test unit came with 3MB of RAM; you can expand up to 16MB, and it all fits on the single card.

There are seven other slots on the motherboard: two 8-bit and five 16-bit. Our test machine came with a Compaq 16-bit VGA adapter (using Paradise chips), a Compaq 16-bit combined floppy/hard disk controller (based in large part on Western Digital chips), and a controller for the internal tape drive. The disk controller also has parallel and serial port connectors on its mounting bracket, which helps conserve slots while providing needed I/O ports.

The evaluation unit also had a full-height 300MB hard disk from Miniscribe. Compaq provided its own version of DOS 3.3 with the disk. This is significant in that DOS 3.3 can address the entire 300MB as a single volume without resorting to special drivers. If you've ever had to struggle with dividing a large drive into a slew of smaller partitions because of DOS's 32MB barrier, you'll appreciate this feature.

The case has room for just four half-height devices, although all bays are open



FACT FILE

Compaq Deskpro 386/25

Compaq Computer Corp
20555 FM 149
Houston, TX 77070
(713) 370-0670

List Price: With 1MB RAM, 60MB hard disk, 1.2MB 5¼-inch floppy disk drive, \$8,299; with monochrome monitor, DOS 3.3, \$8,674; with VGA monitor, \$9,717; with 3MB RAM, 300MB hard disk, 135MB tape backup, 80387 math coprocessor, \$20,213. 1.44MB 3½-inch floppy disk drive, \$275.

In Short: As in the past, Compaq has produced one of the best-built machines in its class and is selling it at a premium price. Its average processor performance is balanced by its fast video, and it remains the best choice for those who can afford to go with a top brand name.

CIRCLE 661 ON READER SERVICE CARD

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Compaq Deskpro 386/25



The Compaq Deskpro 386/25 is a prime example of quality workmanship and design, and the VGA color system price of \$9,717 (with 1MB RAM and 60MB hard disk) reflects the premium you pay for such quality. Compaq's unique design shows in the system case's two full-height openings and in Compaq's hard disk controller, which comes complete with its own parallel and serial ports.



to the outside through the front of the case. In the evaluation unit, with one floppy disk drive and a tape drive, there was no room for another half-height device. In this configuration, a second floppy disk drive would have to be mounted in an external housing.

In terms of performance, the Deskpro 386/25 turned in mixed results. It was not as fast as most others in the processor tests; it came out in the bottom third of the field.

On the other hand, its ESDI hard disk was one of the speediest we saw, and its display times were among the fastest of all. It is likely that the fast hard disk and video results will cancel out the slightly slower processor times in terms of what you will see when working with real applications.

The main question on the Compaq has to be whether the extra effort in design and construction are worth the extra price. If you're ready to buy a top brand regardless

of price, the Compaq competes well against its IBM rival. But if you're trying to maximize performance for your dollar, however, you will find other machines that may not be built as solidly but will offer equal performance for considerably less money.

DELL COMPUTER CORP.

Dell System 325

At a time when many computer manufacturers appear to be moving toward an à la carte approach to system configuration, Dell seems to be heading in the opposite direction. When you buy a computer system from Dell, you get just that—a complete system. And the new top-of-the-line Dell System 325 is a flagship worth putting out in front of the fleet.

Dell's systems are competitively priced in about the middle of the pack. Our evaluation unit came loaded with options and enhancements—and still managed to stay under five figures, at just over \$9,500.

Compared with some of the PC's Limited/Dell designs that preceded it, the System 325 presents a sedate and conservative image. There are no extra switches or lights winking on the front panel—just the power light, the disk access indicator, and a lock. The one variation from the classic AT case is that all three half-height drive

PC MAGAZINE EDITOR'S CHOICE FACT FILE

Dell System 325

Dell Computer Corp.
9505 Arboretum Blvd.
Austin, TX 78759
(800) 426-5150
(512) 338-4400

List Price: With 1MB RAM, 1.2MB 5¼-inch or 1.44MB 3½-inch floppy disk, \$4,799; with 150MB hard disk, monochrome monitor, DOS 3.3, \$7,119; with VGA monitor, \$7,319; with 2MB RAM, 150MB tape backup, 2 floppy disk drives, \$9,519. 1MB RAM upgrade, \$1,000; 80387-25 math coprocessor, \$1,000.

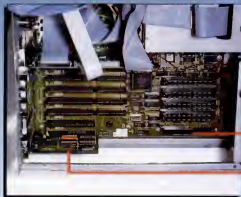
In Short: The Dell System 325 keeps pace with the best in terms of performance, and the combination of price, on-site service warranty, and support materials makes it an exceptional value.

CIRCLE 111 ON READER SERVICE CARD

Dell System 325



The Dell System 325 is well built, with a conservative appearance. At \$7,319, the 1MB-RAM VGA-color system price is a little lower than some of the midrange competition, even though Dell configures the system with a 150MB hard disk. One 8-bit slot can only be used for half-length cards because the rest of the space is occupied by the 32-bit memory card; a full complement of eight slots remain for other add-in boards.



32-bit memory card connector

Half-length 8-bit slot

bays on the right are open through the case front. The evaluation machine had all three filled, with 5¼-inch and 3½-inch floppy disk drives and a Wangtec 150MB streaming tape drive.

Inside, the same conservative design prevails. The motherboard accepts SIMMs, and our evaluation unit held 2MB of 80-nanosecond RAM. The System 325 offers two 8-bit slots and six 16-bit slots. There is also a proprietary 32-bit connector

at the front of the case in line with the left-most slot. The evaluation unit also came with some standard components, such as a Video Seven 16-bit VGA, a Western Digital floppy/hard disk controller, and a fast 150MB CDC hard disk drive.

Not every feature is typical of the other machines in this roundup. The System 325 is one of the three machines in this group that include I/O ports on the motherboard. There are connectors for one parallel and

two serial ports on the back. Depending on your configuration, this design could save some important slots.

SOFTWARE AND OTHER GOODIES

The System 325 also comes with some useful software. In addition to DOS 3.3 and GW-BASIC as standard features, you get VGA utilities, a powerful collection of diagnostic and setup utilities, and some interesting extensions to DOS. The setup disk performs a wide range of diagnostic tests and can also be used to perform a low-level format on a hard disk. The DOS extensions include cruise control, disk caching, and a routine that redirects data sent to a parallel port into a disk file instead. There are some handy file management utilities included, too.

Dell's documentation is generally lucid, well written, and filled with ample illustrations and examples. Compared with the haphazard collection of manufacturers' pamphlets that pass as documentation for some of the smaller competitors, it presents a shining example of coherence and clarity.

Like many other manufacturers, Dell offers a 1-year warranty and a 30-day refund policy. Unlike most others, however, Dell's warranty covers on-site service for the entire year.

Assemble all these elements and you have a complete system. And this system runs fast. In fact, compared with the other eight computers in this group, it produced above-average performance figures for nearly every benchmark test. There is nothing conservative or typical about the speed of this one.

Not all is perfect in Dell heaven, however. Some parts of the machine fail to exhibit the same polish and attention to detail shown in other areas of the design. The most notable example is the case itself. The box is made of a sturdy gauge of metal, and there is plenty of extra shielding in evidence, as around the disk drive bays. But the drive bays themselves have not been finished thoroughly in the manufacturing process; the slots that take the drive rails were not smooth. As a result, it was difficult to slide the disk drives in and out—at times it was a definite struggle. To make matters worse, the drives came with soft metal rails that tended to snag on the

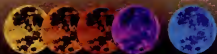
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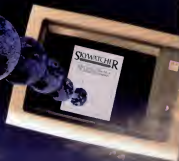
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■ 25-MHz COMPUTERS

rough spots. The soft rails also made it too easy to cross-thread the mounting bolts used to hold the drives in place; in spite of extra care, I managed to do that in one instance. But these problems should be minor: most users will never have to change a drive since the systems will be configured by Dell.

The Dell System 325 is not priced at rock-bottom clone prices, nor is it at the top of the heap. Given the company's stature and increasing reputation for high-quality products, I would tend to downplay the problems with the disk bay fit and finish. This computer provides performance that is only slightly slower than the fastest in its class—and provides it in a complete package at a competitive price with an outstanding warranty. The Dell System 325 is a good value, well worth consideration.

EVEREX COMPUTER SYSTEMS

Everex STEP 386/25

When Everex Computer Systems released its first computer, the impressive Everex STEP 386/20, the only question to ask was, What does the company do for an encore? The answer: Add 5 MHz of power to come up with the Everex STEP 386/25. Now all the company has to worry about is curtain calls.

The STEP 386/25 has a base price of

Everex STEP 386/25



The Everex STEP 386/25 is one of the most communicative machines in the batch. The VGA color system lists for \$7,696 with 1MB RAM and a 40MB hard disk. The case sports a front panel that keeps you posted on its internal operations through messages that flash on the eight-character LED.



FACT FILE

Everex STEP 386/25

Everex Computer Systems
48431 Millmont Dr.
Fremont, CA 94538
(800) 356-4283
(415) 683-2246

List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, DOS 3.3, \$6,399; with 40MB hard disk, monochrome monitor, \$7,222; with VGA monitor, \$7,696; with 4MB RAM, 160MB hard disk, EGA monitor, 80387 math coprocessor, \$14,291.

In Short: Unique design features give the Everex STEP 386/25 a performance edge, but its price also places it amid the upper half of the competition. Even so, it's a good value, representing a good mix of performance and quality for the money.

CIRCLE 89 ON READER SERVICE CARD

about \$6,400; our fully equipped test unit weighed in at a hefty \$14,291. After gasping at the price, the casual observer will immediately be struck by the computer case. It's clearly NYACC: Not Your Average Clone Case. All five half-height disk drive bays are open to the outside, for in these days of multiple floppy-disk formats, backup tapes, and optical disks, you often need more than the typical two or three open bays.

Next to the drive openings is a space covered by a sliding plastic door. Open it up and you will find a collection of useful controls. The top line is dominated by an eight-character LED that flashes messages during the machine's operation. On power-up, this line keeps you posted on the POST (power-on self-test) results, reporting either success or difficulty in abbreviated English. For example, the parity test returns either "PRTY OK" or



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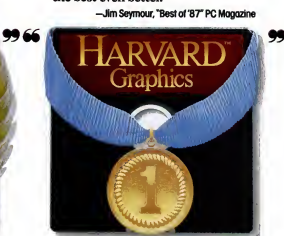


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SHAKEOUT OR SHAKE-UP? A HISTORICAL PERSPECTIVE

History repeats itself, and the PC market is no exception. Is it an illusion, or are we at the beginning of another market shakeout?

Before IBM stabilized the microcomputer market with the successful introduction of the IBM PC in 1981, the theme that best described the industry was "shakeout." This theme seems to be reemerging in 1989.

It's not that things are out of control. If anything, the market has stabilized with the advent of the fast 25-MHz 386, which should remain the power-user standard for some time.

But the world of desktop computers has become a commodity market dominated by clone manufacturers making remarkably similar products. The same thing occurred in much the same way just about a decade ago. Back then, dozens of brand-name machines were essentially pieced together much like today's clone. The result was the popular CP/M machine with its 64K of main memory, a couple of disk drives, maybe a 14-inch hard disk, and a daisy wheel or dot matrix printer attached. This box had a Hazeltine or Televideo or any number of other terminals hooked to it. Price: \$3,000 to \$5,000 or so. If you saw one, you saw them all.

Consumers discovered that the brand name mattered less than compatibility and price. Nobody really offered better performance than the others. In essence, the boxes were all the same. There was the White Computer, the Equinox 100, the Horizon, the CompuPro, the Cromemco—you name it. It was a packaging game augmented by advertising gimmicks, and everyone loved it.

Today isn't much different, since many buyers know one 25-MHz 386 box is as good as another. The machines have become a commodity, and it boils down to price/performance once again.

As price consciousness swept the industry back in the late 1970s, some smart

operators discovered that they could cheaply make a single-board, all-in-one machine more cheaply than an S-100 system with its expensive cards and expensive backplane. Tandy and Commodore had already figured this out and were doing famously by selling their TRS-80 and Commodore 64 machines, in a bargain hunter's market. For serious CP/M machines, though, it was Altos that took advantage of the single-board price breakthrough. Other companies such as Morrow Designs (with its Microdecision) followed suit and designed single-board machines, which were so successful that Morrow failed to see the rest of the world passing it by when IBM introduced the PC.

And during the present commodity-market explosion, we are seeing the reinvention of the single-board machine in the form of the Toshiba T3100/T5100, the Zenith SupersPort 286 and TurboPort 386, and other so-called laptops. This is just the beginning for the single-board phase of the business.

FUTURE PHENOMENA? Is all of this a shakeout or a shake-up? It's really hard to say, because the people with the hot machines at the right prices are doing very well for themselves. It's certainly no shakeout for them.

What can we expect next? Did we learn anything from the last time around, the pre-PC era? We learned that the PC saved the day. Maybe if it hadn't been for the PC, the madness and cost cutting would have continued to this day, giving the low-ball Asian vendors most of the market (since they seem more adept at high-volume production).

What to look for in the months ahead?

Three curiosities began to appear just before the final death of the CP/M world,

and we may see these repeated. There may be others, too.

■ **The Incredible Shrinking Machine Phenomenon.** This happened during the days of CP/M with the "computer in a disk drive" marvel. It was originally an entire Z-80 system with all the necessary ports sold as part of a disk drive in a small disk-drive sized box. Today's sudden eschewing of the large AT box for "small-footprint" machines is a step in this direction. The only 25-MHz 386 to go this route so far is the IBM PS/2 Model 70-A21. But some users may see this as the machine's biggest drawback, rather than as an evolutionary advantage, because of the expansion-hungry applications for which they are buying the computer.

■ **The Computer-on-a-Card Phenomenon.** Another curiosity from years back is the complete computer on a small card to which one only has to add a disk drive and a terminal to make a complete CP/M machine. The card can then be installed inside the terminal. There's no real analogy for this in today's market, although the Taiwanese replacement motherboards come close in concept.

■ **The Mysterious Appearance of Oddball Systems.** Last, there is the introduction of one oddball system after another, each looking to attract attention to itself by some sort of uniqueness. Early Z-8000 machines come to mind from years ago. The NeXT machine comes to mind today.

These phenomena will develop until another "IBM PC" kind of product comes along to save the day. We may have a bit of a wait because the 25-MHz 386 will be with us for some time.

—John C. Dvorak

John C. Dvorak is a contributing editor of PC Magazine.

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■ 25-MHz COMPUTERS

"PRTY ERR." The same display reports other status information during operation, such as the drive, cylinder, and head being accessed.

This hidden front panel also includes power and disk-access indicators, and another set of lights to show whether the system is running at its high (25-MHz), middle (12.5-MHz), or low (8-MHz) speed. A switch allows you to choose between high and low, although you can also use the keyboard to select the speed.

The panel also holds the system lock and a handy hardware reset switch. Another feature, which is found on few other systems but can be priceless in some circumstances, is a switch that lets you toggle the speaker on and off.

The computer comes with equally friendly printed material. The system manual is well written, sufficiently illustrated with clear and concise drawings, and filled with useful information. For example, it contains a listing of the different hard-disk-drive types and their numbers for the configuration program.

INTERIOR DESIGN Inside the computer you'll find further evidence of a unique approach to design. The STEP 386/25 uses Everex's own motherboard, which offers a typical complement of one 8-bit and six 16-bit slots. The eighth slot is a proprietary 32-bit design, but the extended connector is located toward the front of the case. This leaves a standard 8-bit connector at the back that can be used for an 8-bit expansion card in case you do not need the 32-bit memory expansion card.

And you may never need the memory card. The STEP 386/25 uses SIMMs on the motherboard. The base unit comes with 1MB of memory, but you can install up to 8MB on the motherboard. This will be more than enough for most users now, even if you are running OS/2.

The memory is laid out so that it lies at the end of slots 3, 4, 5, and 6. You can use full-length cards in these slots even with a full complement of memory installed, as long as the cards are not thick. You may have trouble if you're using a hard disk card or expansion cards with daughterboards, but since you can use the other four slots for these thicker cards, this is not likely to be a problem.

The STEP 386/25 uses Everex's own BIOS, based on the popular AMI BIOS, and includes CMOS configuration setup routines in ROM that can be called during power-up. This computer is atypical in that it uses EEPROM (electrically erasable programmable read-only memory) to store motherboard configuration settings. While most users will never have to exploit this feature (and indeed, the manual warns against casual exploration of this capability), it does simplify the task of configuring the number of SIMM banks installed, the chip size, the setting of cache memory, and other performance settings.

One unusual aspect of this "switch-less" configuration approach is that it includes the size of the memory cache. Un-

**The STEP 386/25
lets you increase
the size of the cache
to a total of 256K,
far larger than
competitors offer.**

like any other machine tested here, the STEP 386/25 lets you increase the size of the cache to a total of 256K, far larger than competitors offer.

TESTED RESULTS This machine really performs; it finished first in two out of three processor benchmark tests. Everex shipped the evaluation unit with a CDC 160MB hard disk, which was one of the fastest drives tested.

The one place where the STEP 386/25 really fell down was on the video benchmark tests, where it was among the slowest. Perhaps that is because the evaluation unit came with an 8-bit EGA adapter, while its competitors were running VGA, many through 16-bit cards.

This computer is built solidly and is

based on careful design, as confirmed by its Class B FCC rating. It runs ahead of the pack in performance, although others come extremely close to matching its results. The Everex STEP 386/25 is a little different and in some ways a little better than much of its competition. Its price also puts it up in the top half of the pack, however, so you may consider carefully how much extra you are willing to spend to get the fastest machine going. If money is no object, you may consider bringing this crowd-pleaser into your office.

HERTZ COMPUTER CORP.

Hertz 386/25

The Hertz 386/25 is a machine of remarkable quality and finish that is built around the Intel System 302. In this instance, Intel supplies not only the motherboard but also the power supply and the case. The system has been designed as a total unit, in part to meet FCC radio-frequency-emission standards. As a result, the Hertz 386/25 computer comes with the prestigious Class B sticker.

While this quality costs more than some of the alternatives, the price of the Hertz 386/25 falls in the middle of the field. Our fully configured evaluation unit, complete with 300MB drive, costs \$10,375.

Don't think that Hertz is getting stuck by having to use the Intel case. While the 386/25 is about the same size as a standard AT-style computer, the two-tone front sports an attractive and dramatic stepped panel next to the disk drives. This extension creates extra space behind the left side of the case.

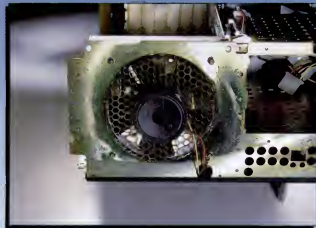
When you take off the cover, you see the reason for the extra space. There is a large 5-inch muffin fan mounted on the front of the expansion card cage. This fan moves plenty of air across the motherboard and any expansion cards, helping to dispel the heat that is a computer's worst enemy.

The inside of the case is a model of solid construction. Heavy-gauge metal is used throughout, including a hefty shield around the disk bays. The surfaces have been anodized with a gold-colored coating, presumably to help control RF emissions, but adding an attractive aesthetic touch that demonstrates extra production

Hertz 386/25



The Hertz 386/25 not only comes with a 25-MHz Intel 80386 processor, it has an Intel chassis, case, and power supply. The VGA color system is midpriced at \$7,183, but comes with a full 2MB RAM in addition to a 40MB hard disk. The machine is solidly designed and built, as demonstrated by the large muffin fan mounted on the front of the case to cool the motherboard and expansion cards.



effort at the same time.

There are five half-height drive bays, and all three on the right side can be opened through the front of the case. The evaluation machine had a full-height Micropolis 300MB hard disk on the left and a pair of TEAC 5¼- and 3½-inch floppy disk drives on the right. With three openings in the case, there was still room for another device such as a tape drive.

The motherboard also boasts a solid de-

sign. Memory is installed in SIMMs, and the evaluation machine had 2MB using 256Kb chips rated at 60 nanoseconds. You can also buy 1Mb chip packs, yielding up to 8MB of RAM on the motherboard without resorting to an expansion card.

Should you need more memory, you can add up to two cards using the pair of proprietary 32-bit slots running at the full 25-MHz speed. Expansion cards come equipped with 8MB of memory, meaning



FACT FILE

Hertz 386/25

Hertz Computer Corp.
325 Fifth Ave.
New York, NY 10016
(212) 684-4141

List Price: With 1MB RAM, 1.2MB 5¼-inch floppy disk drive, \$5,765; with 2MB RAM, 40MB hard disk, monochrome monitor, DOS 3.3, \$6,457; with VGA monitor, \$7,183; with 300MB hard disk, 1.44MB 3½-inch floppy disk drive, 80387 math coprocessor, \$10,375.

In Short: Built on a motherboard and case package from Intel, the Hertz 386/25 uses quality components and solid construction backed by an on-site warranty, but its price makes it a less attractive value than some of the alternatives.

CIRCLE 666 ON READER SERVICE CARD

that you can configure the machine with a whopping total of 24MB if you wish.

The motherboard includes a 64K bank of static RAM rated at 30 nanoseconds. The motherboard is also designed to move system and video BIOS into shadow RAM to improve performance.

There are five 16-bit slots and one 8-bit slot on the motherboard. On the evaluation unit, these contained a Western Digital ESDI controller and a 16-bit Video Seven VGA adapter. This configuration leaves plenty of slots open for expansion. You may notice that there are no parallel or serial ports on the expansion cards; that's because the motherboard includes one parallel and two serial ports (with 9-pin connectors), mounted on the back panel to the left of the card cage.

NO PRIZES FOR DOCUMENTATION

The documentation is just adequate. The system manual is merely the Intel documentation "written primarily for the OEM user. . . [containing] . . . much information that can be passed to the end user." Hertz's concept of passing the information along is reprinting the manual. All the information required is in there, but it helps to have some experience if you are going to find what you need. There are separate manuals for the software caching program from Golden Bow Systems and for the video adapter from Video Seven. Hertz also

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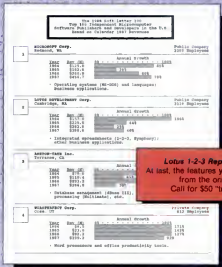
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■ 25-MHz COMPUTERS

supplies Ontrack Computer Systems' *Disk Manager* on a floppy disk, which includes a file of documentation.

Warranty service, by contrast, is outstanding. Hertz includes a full year of on-site service through Intel. This service is available throughout the U.S. and Europe as well as other foreign locations.

System performance was among the slowest on every processor test. But keep in mind that the difference between the top and bottom performers in this group is fairly small when compared with the difference between the slowest 25-MHz machine and a typical 16-MHz 386. Also, the 386/25 had some of the fastest display times and came with a hard disk that turned in results under 20 milliseconds, so you are not likely to notice the speed differences between this and most of the other machines tested here.

The biggest problem faced by the Hertz system is its price. It costs significantly more than some of the other lesser-known brands, although it does list for less than some of the better-known players in the market. The extra cash covers the solid, integrated design provided by Intel, along with the on-site warranty coverage.

Overall, the premium price of the Hertz 386/25 does not appear to be matched by premium performance. Some users may be attracted by its thoroughbred heritage and quality construction, but most will probably decide that better values are available elsewhere.


IBM CORP.

IBM PS/2 Model 70-A21

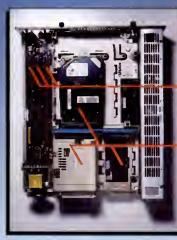
The IBM PS/2 Model 70-A21 asks the question, How many expansion slots would you sacrifice in order to reclaim the space on your desk? This machine does offer a tempting amount of 386 power from Big Blue itself, running at a hyperactive 25 MHz. But it also has an imposing price tag—\$15,958 for our evaluation unit—making it the second-most-expensive unit in its class.

The Model 70-A21 shares the familiar small-footprint design of its PS/2 compatriots. Its construction recalls the DEC Rainbow, which was the only other computer I know that could be disassembled completely and put back together using no

IBM PS/2 Model 70-A21



The IBM PS/2 Model 70-A21 is the top performer in the PS/2 line. At \$12,608 for a VGA color system with 2MB RAM and a 120MB hard disk, it is also the top-priced machine among the 25-MHz computers reviewed. While it includes video and I/O ports on the motherboard, the design is still limited by the existence of only **three expansion slots**, two 32-bit and one 16-bit Micro Channel, and only **one available half-height drive bay** in addition to the hard and floppy disk drives already present.



Three expansion slots

Three half-height drive bays

tools aside from a dime and a pencil. The components go together like Lego pieces. Everything slides, clicks, or snaps together; it's incredible how uncluttered the interior looks without the typical mess of power connectors and ribbon cables.

The internal components are all IBM (or built for IBM) and for the most part have a look all their own. The evaluation unit had a single 3½-inch floppy disk drive and a hard disk buried in the back of the

machine. There is room in the case for one other floppy disk drive, but no room for a second hard disk.

The motherboard uses SIMM chips to hold the RAM, and the evaluation unit came with a 32-bit expansion card as well. Both the motherboard and the expansion card use 80-nanosecond RAM chips. Each can hold up to 8MB of RAM, although the test unit had only 2MB installed in each.

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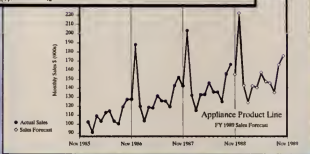
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Mean	129	Mar 1989	163	165	157	0.84
Std Deviation	24	Apr 1989	161	165	155	0.82
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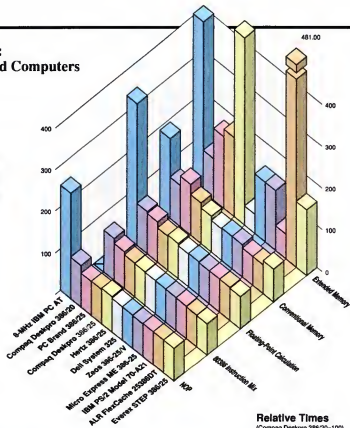
The **NOP** benchmark test is designed to measure raw clock speed and memory access time while minimizing differences in microprocessors and the effect of memory caching. This test executes almost nothing but NOP ("No Operation") machine code instructions in a big 128K loop.

The **80386 Instruction Mix** benchmark test measures the time it takes to execute a selected series of processor-intensive tasks. The test program uses 80386 instruction code. These instructions are a subset of the total processor instruction set. The 80386 Instruction Mix implements a number of 32-bit operations. In the 80386 processor these become single instructions, whereas in the 8086 and 80286 versions of the benchmark test they remain multiple instructions.

The **Floating-Point Calculation** benchmark test measures processor speed by looping through a series of floating-point calculations, including multiplication, division, exponentiation, and logarithmic and trigonometric functions. The benchmark program uses the floating-point library included with Microsoft C Compiler 4.0.

The **Conventional Memory** benchmark test allocates 256K of conventional memory and treats it as a series of 64-byte records. Then, 16,384 random records are read into and written from this memory. The result shown is the average of the read and write times.

The **Extended Memory** benchmark test allocates 256K of extended memory and treats it as a series of 64-byte records. Then, 16,384 random records are read into and written from this memory. The result shown is the average of the read and write times.



Performance Times (Times given in seconds)

	NOP	80386 Instruction Mix	Floating-Point Calculation	Conventional Memory	Extended Memory
8-MHz IBM PC AT	4.17	N/A	35.60	0.77	11.62
Compaq Deskpro 386/20	1.65	2.91	10.50	0.40	2.87
PC Brand 386/25	1.34	2.58	10.01	0.49	4.96
Compaq Deskpro 386/25	1.35	2.38	8.55	0.39	5.47
Hertz 386/25	1.40	2.35	8.86	0.34	12.85
Dell System 325	1.34	2.31	8.35	0.30	1.33
Zeos 386-25/V	1.34	2.30	8.53	0.31	4.13
Micro Express ME 386-25	1.32	2.29	8.33	0.31	4.14
IBM PS/2 Model 70-A21	1.34	2.28	8.35	0.28	1.69
ALR FlexCache 25386DT	1.34	2.24	8.30	0.28	13.81
Everex STEP 386/25	1.33	2.22	8.07	0.32	4.50

The current crop of 25-MHz 80386-based machines continues the push toward faster processors, but standard bus speeds remain. Like their 20-MHz cousins, most of these 25-MHz 80386-based machines maintain an 8-MHz bus (8.33 in many machines) to assure hardware compatibility with older third-party boards.

On most of our tests, the entire group achieved impressive speeds without dramatic differences between the slowest and fastest

among them. Compared with the other computers, the Hertz 386/25 and the Compaq Deskpro 386/25 were undistinguished on processor and memory tests, although the Compaq was in the forefront on disk benchmark tests.

The fastest processor was the Everex STEP 386/25, and the Dell System 325 was close to the top throughout all the tests, with no weaknesses. The IBM PS/2 Model 70-A21 was a front runner on processor and memory tests, and the ALR FlexCache 25386DT kept pace with it (except on Extended Memory); both of these use 25-millisecond drives, however, which is slow for this class of machine.

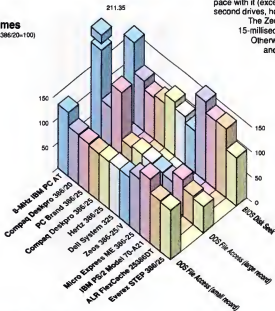
The Zeos 386-25/V and PC Brand 386/25 use blazingly fast 15-millisecond hard disks—you can't do much better than that.

Otherwise, the Zeos takes the middle road in processor and disk access tests. The PC Brand came in last on two out of three processor tests, with slower memory times than the older Compaq 386/20 (not reviewed here, but reported for the sake of comparison, along with the IBM PC AT). That result is primarily caused by

the lack of an optional memory caching board in the unit we tested. The PC Brand's fast VGA and hard disk, as well as its low price, still make it a standout.

Relative Times

(Compaq Deskpro 386/20=100)



Performance Times

(Times given in seconds except where indicated)

	DOS File Access (small record)	DOS File Access (large record)	BIOS Disk Seek (milli- seconds)
8-MHz IBM PC AT	72.63	19.74	29.20
Compaq Deskpro 386/20	56.78	9.34	18.10
PC Brand 386/25	55.33	13.77	15.16
Compaq Deskpro 386/25	53.65	4.88	16.20
Hertz 386/25	54.04	5.28	19.66
Dell System 325	55.17	5.21	17.37
Zeos 386-25/V	55.26	5.05	15.10
Micro Express ME 386-25	62.83	4.86	28.78
IBM PS/2 Model 70-A21	72.37	6.77	24.79
ALR FlexCache 25386DT	56.92	5.29	25.01
Everex STEP 386/25	55.67	4.86	17.48

Disk Benchmark Tests

The DOS File Access benchmark test measures the throughput rate of the disk being tested. In this case, throughput times are measured in terms of how long the disk takes to perform common DOS file-management functions. Five tasks—file creation, sequential file write, sequential file read, random file write, and random file read—are timed and the results summed.

The test is carried out for two different types of files—small-record files and large-record files—that are used by common PC applications. Files created using small records are typically used by database management programs, and large records are typically used for word processing and spreadsheet files. Loading a DOS program is also simulated by the large-record test.

The BIOS Disk Seek benchmark test measures the time it takes to do a random seek using the disk's ROM BIOS. The test result includes minimal software overhead and may not parallel the manufacturer's claimed average access time. The test program performs 1,000 seeks. The average result is shown in milliseconds.

(continues)



Benchmark Tests: 25-MHz 386-based Computers

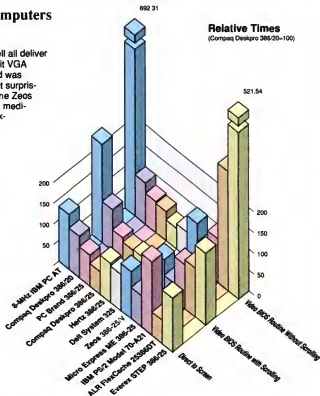
Compaq, Micro Express, Hertz, and Dell all deliver very fast video speeds with their 16-bit VGA cards. The Everex machine that we tested was equipped with an EGA video card and, not surprisingly, turned in the slowest video times. The Zeos used an 8-bit VGA video card and yielded mediocre times. IBM and ALR have no such excuses. Both use 16-bit VGA cards, but IBM's video times are no better than so-so, while ALR's very fast Direct to Screen time and poor Video BIOS Routine with Scrolling times suggest a fast 16-bit card crippled by slow BIOS.

Video Benchmark Tests

The Direct to Screen benchmark test measures the bandwidth of the video adapter by writing directly to the display memory buffer. The test is performed in video mode 3. The entire screen is updated using the assembly language REP STOSW instruction with register CX equal to 2000. This is done 1,000 times, and the result shown is the total of the 1,000 trials.

The Video BIOS Routine with Scrolling benchmark test measures the speed of the BIOS Teletype routine with scrolling. The test is performed in video mode 3. The screen is cleared and 240 lines of 60 characters each (including a terminating carriage return and line feed) are written to the display through the BIOS Teletype routine. Although the first 24 lines written to the display do not involve scrolling, all the remaining lines scroll the display.

The Video BIOS Routine Without Scrolling benchmark test measures the speed of the BIOS Teletype routine without scrolling. The test is performed in video mode 3. The screen is cleared and 24 lines of 60 characters each (including a terminating carriage return and line feed) are written to the display through the BIOS Teletype routine. This is done ten times, and the result shown is the total of the ten trials.



Performance Times

(Times given in seconds)

	Direct to Screen	Video BIOS Routine with Scrolling	Video BIOS Routine Without Scrolling
8-MHz IBM PC AT	4.90	7.60	4.50
Compaq Deskpro 386/20	3.70	3.20	0.65
PC Brand 386/25	2.75	1.65	0.49
Compaq Deskpro 386/25	2.01	1.32	0.46
Hertz 386/25	3.49	1.39	0.33
Dell System 325	3.26	1.57	0.40
Zeos 386-25 V	4.23	2.52	0.66
Micro Express ME 386-25	2.85	1.33	0.37
IBM PS/2 Model 70-A21	6.57	3.41	0.68
ALR FlexCache 25386DT	2.09	3.79	1.87
Everex STEP 386/25	4.84	5.56	3.39

(ends)

Once again,
we're about to place
the future right
in your lap.



LOW BAT

POWER
ON
SW

Sys Rq F1 F2 F3 F4 F5 F6 F7 F8 F9 F10 F11 Scr Set Lock F12 Pause Break
Esc

1 ! @ 2 3 4 5 6 7 8 9 0 - + Back Space

Tab Q W E F T Y U O P [\] ^ _ `

Caps Lock A S D F G H J K L ; ' ~ Enter

Shift Z X C V B N M , < . > ? / Shift

Ctrl Alt Alt

Fn

Home Pg Dn End

NEC
UltraLite

At NEC, we've seen the future. And it measures precisely 8.3" x 11.75" x 1.4". Introducing the UltraLite.[™] The lightest, thinnest, full-function laptop computer. Weighing in at 4.4 lbs., it boldly goes where no laptop has gone before: right in your briefcase.

Of course, the true measure of a laptop is not just its width and length. Equally important is its depth.

With a 10MHz NEC V-30 processor, the UltraLite has 90% of the power of the original IBM AT. Plus a main memory of 640K, a full-size industry standard keyboard, and built-in Microsoft DOS Manager and Lap-Link software. It also has a large, bright backlit screen that supports both text and graphics.

For storage, it has an innovative one or two megabyte silicon hard disk, which provides access to data several times faster than a conventional hard disk.

And what's more, there's also a slot for NEC's unique high-speed ROM cards which give you the opportunity to increase your storage capacity. Each ROM card contains a popular software program, yet it's about the size of a credit card.

Impressed? So was *PC Magazine*, which just named the UltraLite "Portable Computer of the Year for Technical Excellence." See your NEC dealer for a demonstration. You'll agree, when it comes to laptops, there's never been anything NEC UltraLite[™] quite as big.

Wherever
you can
put this
magazine,
you can
now put a
computer.

Introducing the laptop computer

Problems, problems, problems.

Computers were designed to solve them.

But sometimes they've been known to cause a few of their own. Example: You just purchased a laptop. At first, everything seems fine. But soon you want to expand your data base. Use more

sophisticated

software. Link-up to local area networks. When you realize you can't, you begin to ask yourself: Where's the power? Where's the expandability?

Where's the receipt?

Introducing an end to all your problems. The ProSpeed™ 286, from NEC. Weighing under 15 lbs., the ProSpeed 286 is surprisingly light. But in other areas, it's a real heavyweight. Like expandability, connectivity and speed. In fact, it offers the full functionality of a high-

performance desktop. The ProSpeed comes equipped with one megabyte of memory that's expandable to five. And, it comes with either 20 or 40 megabyte hard disk drives. There's even an advanced model that provides a high-speed 100 megabyte drive for special applications.

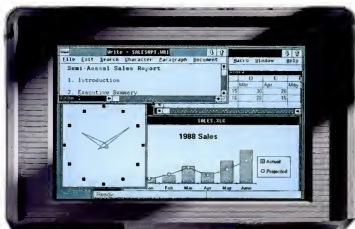
As for its display, it clears up a very serious problem: clarity. NEC's Monograph™ CTN screen gives you crisp, backlit images that provide CRT quality with VGA resolution.

For power-hungry executives, the ProSpeed 286 is powered by a CMOS 80286

processor running at 16MHz. Meaning it's fully capable of

The ProSpeed 286 screen is so clear and crisp you can even display multiple windows.

The ProSpeed 286 Expansion Station gives you the flexibility and expandability of a high-performance desktop computer.



that solves problems others can't.

such as
Microsoft
Excel. And then
there's the ever-
expanding problem of
expansion, for which NEC has
developed a unique solution
called an Expansion
Station.[™] It's an innovative
system that includes four stan-
dard slots, one standard
drive bay, a power supply
and permanent con-
nections for both
printer and serial devices.

*The ProSpeed 286
features a full-
function keyboard
with standard
spacing.*

Admittedly,
there's one problem we
can't solve. Whether to use
the ProSpeed 286 as a laptop
or desktop?
That's one you'll just have to
tackle yourself.

DOS, Windows and Microsoft Excel are registered trademarks of the Microsoft Corp. OS/2 is a trademark of International Business Machines Corp. WordPerfect is a registered trademark of WordPerfect Corp. Paradox is a registered trademark of Borland International. Monograph is a trademark of Monograph, Inc.

handling
the most demand-
ing DOS applications.
Not to mention OS/2 Presentation
Manager and Windows applications

NEC ProSpeed[™] 286

In order to make the ultimate desktop comp

Our sincere apologies to desk makers everywhere.

But when we set out to make the ultimate desktop computer,

we knew it had to have three critical components. Awesome power. Unequaled expansion capabilities.

And most importantly—a handle.

Introducing the ProSpeed™ 386 from NEC. The first personal computer to offer the portability of a laptop and the power of an 80386 desktop.

With the ProSpeed 386, the designers at NEC did more than create a new computer. They

You've never had this much power sitting in your lap.

established a new class of computers—the first modular workstation.

To realize how this can benefit you in the future, let us remind you how it was in the past.

With ordinary laptops you had to hook and unhook peripherals, phone lines and all sorts of cables every time you left the office.

But thanks to a revolutionary Docking Station™ design, the ProSpeed 386 leaves all that behind.

You simply slide the laptop out of the Docking Station, and then slide out of your office. Leaving all your connections connected for when you return.

And saving yourself



Snap the ProSpeed 386 into the Docking Station, and it's a desktop. Snap it out and it's a laptop.



uter, we had to remove one major obstacle.

one of the most precious commodities of all—time.

Most importantly, the Docking Station can accommodate a full range of expansion options; it has four full-size card slots, and two standard drive bays for tape back-up, CD-ROM or 5¼" floppies.

Take away the Docking Station and what have you got? One of the world's most powerful laptops.

Running at 16MHz, it offers two megabytes of 32-bit memory that's expandable to 10.

It's equipped with a hard disk and is available with either 40 megabytes or 100 megabytes of storage capacity.

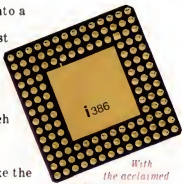
As for its 10½" diagonal black-on-white display, it's positively brilliant.

Advanced screen technology delivers a paper-white image and EGA resolution.

In more ways than one. NEC's advanced screen technology, called Monograph™ CTN, provides CRT-quality video with a paper-white image and EGA resolution.

Which translates into a higher level of contrast and increased resolution for graphics-oriented programs, such as Windows.

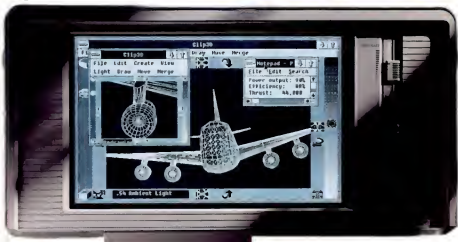
Which helps to make the ProSpeed 386 not just the ultimate desktop, but the ultimate value. Whether your



With the acclaimed 386 chip, ProSpeed delivers exceptional speed and full multitasking capabilities.

desk has four legs or just two.

NEC ProSpeed™ 386



For a closer look at the future, see your NEC dealer. For product literature, call 1-800-826-2255.

For technical details, call NEC Home Electronics (USA) Inc. at 1-800-FONE-NEC.

*ProSpeed™ 386.
40 or 100 megabyte
modular workstation with
all the power of an
80386 desktop.*

*MultiSpeed™ HD.
Lightweight 20
megabyte laptop.*

*ProSpeed™ 286.
The fastest
80286 laptop.*

*UltraLite™
The lightest, thinnest,
full-function laptop.*

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C&C

Computers and Communications

NEC

■ 25-MHz COMPUTERS

parallel, and mouse ports, as well as VGA adapter circuitry. There is 64K of static RAM as a memory cache to enhance performance.

Since this is a PS/2, the motherboard also has two types of Micro Channel expansion slots. Of the three expansion slots in the machine, one is of 16-bit design with display adapter extensions, while the other two are of 32-bit design (and incompatible with the 16-bit). The video extensions are for use with an optional 8514/A video adapter.

Thus, you have few expansion slots to start with, but only one 16-bit. This can severely limit your options. The power supply offers a mere 132 watts, which is not likely to be a major problem since you can't add too much in the first place.

The 70-A21 turned in respectable performance times. Its processor times were better than average, and its conventional and extended memory results were some of the best. On the other hand, its 120MB ESDI hard disk was one of the slowest tested. And in spite of having VGA on the motherboard, the computer produced some of the slowest display speeds.

POINTS OF STRENGTH The 70-A21 has three strong points in its favor that distinguish it from its competitors. It takes up less real estate than any of the other machines in this review (with the exception of the Zeos in a vertical case). The 70-A21

also has the IBM keyboard, which may be noisy—it does make little *boings* caused by the spring within each key—but it still has the touch that many users consider the standard of comparison. And third, the machine comes from IBM.

The IBM PS/2 Model 70-A21 was one of seven small-footprint computers reviewed in "The Size Is Right: Packing 386 Power into Sleek PCs," (*PC Magazine*, November 15, 1988). As the only 25-MHz machine in the group, it received Editor's Choice for its sleek design and quicksilver times. When the 70-A21 is compared with its 25-MHz 386 competitors, however, that sleek design is precisely what loses points. Anyone in the market for such a powerful computer will most likely need the expansion opportunities offered by other computers in this roundup. If you buy the 70-A21, you can't expect to add much to the base machine you initially purchase.

The \$11,295 question (base price without monitor) is whether you focus on the strengths or the weaknesses. If you want a 25-MHz 386 machine and it has to say IBM on the front, you won't regret investing in the 70-A21. If expansion is an issue, if you need tape drives and network adapters and large hard disks, then this isn't the machine for you at any price. If you fall somewhere in the middle, you'll probably find that the 70-A21 doesn't represent an optimal value in the current market, and you would do better to look at what some of the others have to offer.

MICRO EXPRESS INC.

Micro Express ME 386-25

It looks like an AT clone. It's priced like an IBM AT (back when you could still get one). But its performance figures are anything but ordinary as it sits firmly in the middle of the 25-MHz 386 pack. If you're budget-minded and power-crazed, sit up and take a look at the Micro Express ME 386-25. A complete system can cost as little as \$4,239, and even with extra memory and a large hard disk our evaluation unit cost just slightly more than \$7,100.

This computer comes in a standard AT-style case. It has five half-height drive



FACT FILE

Micro Express ME 386-25

Micro Express Inc.
2114 S. Grand Ave.
Santa Ana, CA 92705
(800) 642-7621
(714) 662-1973

List Price: With 1MB RAM, 40MB hard disk, 1.2MB 5¼-inch floppy disk drive, \$3,999; with monochrome monitor, DOS 3.3, \$4,239; with VGA monitor, \$4,823; with 4MB RAM, 140MB hard disk, 80387 coprocessor, \$7,122. 1.44MB 3½-inch disk drive, \$129; 60MB tape backup, \$599.

In Short: Low price coupled with high performance makes this machine worth a second look. Its power and flexibility are offset by poor documentation and the use of some unfamiliar components, but for the technically self-reliant user, it remains a terrific value.

CIRCLE 654 ON READER SERVICE CARD

bays, and all three on the right have openings in the case front. You can fit in both 5¼- and 3½-inch disk drives, as well as a tape backup unit, without having to resort to an external housing for one of the three. The case has power and disk-access indicator lights, as well as a handy reset switch.

When you take off the cover, you'll find an American Megatrends motherboard—the same as the one used in the Zeos machine reviewed here (and these were the only two duplicate motherboards in the entire pack). The design has a single 32-bit slot, an 8-bit slot, and six 16-bit slots. The 32-bit slot is based on a proprietary design, but the extra edge connector is placed toward the front of the case, leaving a standard 8-bit connector at the back.

One curious feature is that this motherboard will accept a wide variety of memory components. There are sockets for DIP chips and strips for SIMMs. The sockets are an unusual shape, a result of their ability to accept 256Kb and 1Mb chips as well as the 4Mb chips that have yet to become available in significant quantities. The SIMM slots are equally flexible; they can accommodate modules with 256Kb, 1Mb, or 4Mb chips. Perhaps most remarkable is that you can install memory of both sorts. Using 1Mb DIP and SIMM memory, you can get a full 8MB of memory on the



FACT FILE

IBM PS/2 Model 70-A21

IBM Corp.
Contact your nearest authorized IBM dealer.
(800) IBM-2468

List Price: With 2MB RAM, 120MB hard disk, 1.44MB 3½-inch floppy disk drive, \$11,295; with monochrome monitor, DOS 3.3, \$11,720; with VGA monitor, \$12,608; with 4MB RAM, 80387 math coprocessor, DOS 4.0, \$15,958.

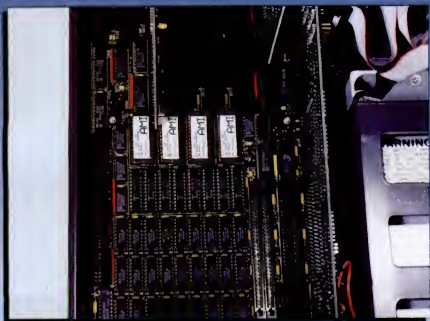
In Short: This desktop saver offers premium performance for a premium price. Its sleek design may be the one reason it's wrong for you; with only three expansion slots and three half-height drive bays, you may not be able to add all the extras you need for storage-hungry applications.

CIRCLE 655 ON READER SERVICE CARD

Micro Express ME 386-25



The Micro Express ME 386-25 is one of the least expensive machines in the group; the color VGA system with 1MB RAM and 40MB hard disk checks in at \$4,823. Like the Zeos 386-25/V, it uses an American Megatrends motherboard, which has unusual sockets for RAM chips. These sockets can accept either 256Kb or 1Mb chips, as well as the new 4Mb chips once they become available in quantity.



motherboard without resorting to an expansion card. And in that glorious future when you can pick up 4Mb chips for a few bucks apiece, you'll be able to get a whopping 32MB of RAM all on the motherboard.

The motherboard also incorporates a full 64K memory cache, operating with 25-nanosecond static RAM chips. Teamed with the 25-MHz CPU, the cache helps the computer churn through instructions with

impressive speed. The ME 386-25 turned in benchmark-test performances that placed it in the middle of the competition, comparing respectably with machines from better-known sources such as Compaq and Dell.

ASSORTED COMPONENTS That leads to the main problem with this computer: Who is Micro Express? The company does not have the production power or

reputation of some of the more famous competitors. In fact, the ME 386-25 is essentially a "stock" product assembled from third-party components.

Many of these "off-the-shelf" parts are familiar, from the Maxi-Switch keyboard to the TEAC floppy disk drive and the NEC MultiSync II monitor. It should be no surprise that the machine comes with AMI BIOS, with setup software in ROM, since AMI built the motherboard.

Other items are less well known, however. For example, instead of the typical Western Digital disk controller, Micro Express included one from DTC (Data Technology Corp.). The serial/parallel I/O card is from Everex.

While these various components may be no better or worse than the more proprietary designs offered by the big names, there is one area that clearly suffers as a result. Documentation is minimal at best. For the most part it's a bunch of pamphlets from the manufacturers of the various components. There is also a Micro Express booklet that purports to cover its 286 and 386 computers, but the manual appears to apply more directly to IBM ATs than to Micro Express products. The illustrations look so much like those in the IBM manuals that one picture of the case shows the initials "IBM," as does the diagnostic diskette label in another picture. The text instructs you to "get the Diagnostics diskette located in the back of your 'Guide to Operations' manual." It's a curious instruction, since Micro Express does not provide a manual with that title.

The upshot of the documentation problem is that you'd best be fairly self-reliant and confident in your ability to work with MS-DOS computers in general if you're going to live with this one. You can find most of the information you'll need in one place or another, but you must have some prior knowledge to locate and correctly interpret it.

If you feel up to that challenge, however, and are in the market for champagne performance on a beer budget, then you'll want to check out the Micro Express ME 386-25. For less than half the price of some competitors, you can end up with a computer that looks unassuming but quietly keeps up with some of the fastest machines on the market.

To Choose The Right Computer, You Have To Look A Little Deeper.

The 32-bit interleaved memory card provides faster processing speed and comes standard with 2 megabytes of RAM.

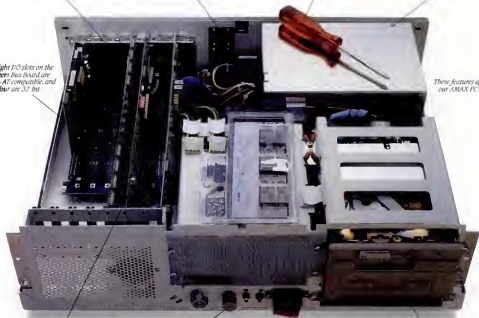
Additional parallel/serial ports can be located in the chassis.

Our special PC/386 toolbit includes a perfectly sized screwdriver allowing easy opening and closing of the case without damaging the screws.

Power supply is UL approved.

All eight I/O slots on the system bus board are 100% AT compatible, and four are 32-bit.

These features apply to our AMAX PC/386.



The Intel 80386 based PC/386 features a replaceable 32-bit CPU card, which gives you complete upgrade capabilities.

Speaker volume control is front mounted, and user adjustable, allowing you to quickly adapt your AMAX PC/386 to any working environment.

The convenient front mounted on-off switch provides easy access, which means you can tuck the PC into a corner of your desktop and save space.

The five standard half-height disk drive slots allow for additional disk drives, tape backups, and hard disks as your needs grow.

These days it seems a lot of PC makers would rather show you a beautiful outside than reveal what's behind it. But at AMAX, we're so proud of our line of high performance, IBM*-compatible PCs that we want the world to see exactly what makes them the best in the business, inside and out.

Of course, building a truly dependable computer requires more than quality materials and quality fabrication. It also takes a commitment to quality control, and that's where we're

All run at 0-Watt States

at our best. Before an AMAX PC leaves the plant, all systems and components undergo rigorous testing and evaluation including an extended "burn-in" period at temperatures ranging from 110° to 150°F. And our commitment continues after the sale, with long-term technical phone support, quick turnaround service and a 12-month limited warranty.

Scratch the surface a little deeper, and you'll find that AMAX PCs run all PC and MS-DOS compatible software with ease. And that our architecture meets or exceeds industry standards for PC compatibles. And speaking of scratches, we certainly don't neglect our sleek exteriors, either. If there's so much as a single blemish on an AMAX chassis, it's immediately rejected.

Finally, you won't have to dig a little deeper to pay for it all, because our price/performance ratio makes AMAX an eminently affordable buy. For a dealer near you, call us today at 800-888-2629, ext. 386. Once you look into AMAX, we think you're going to like what you see.

AMAX

We're Building A Computer You Can Live With.



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AMAX Engineering Corp., 47315 Mission Falls Court, Fremont, CA 94539

CIRCLE 179 ON READER SERVICE CARD

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It's sophisticated, but it's also fun and easy.

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For more information, contact your nearest dealer or call (800) 443-4200.

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CIRCLE 743 ON READER SERVICE CARD

■ 25-MHz COMPUTERS

PC BRAND INC.

PC Brand 386/25

You might expect that your choices are limited to either paying a lot for innovative design or saving money with a "me too" clone. But fortunately you can get unusual features in a low-cost box. The PC Brand 386/25 is living proof. Our fully configured test unit lists for just under \$6,000—less than the cost of most competitors' base-level systems.

Before praising the other attributes of this computer, I should point out the benchmark-test results. It is true that the PC Brand machine finished last in several of the processor tests. In order to put these results in perspective, remember that this computer is typically 1½ times as fast as a 16-MHz Compaq 386, and the fastest machine in this group is about twice as fast as that Compaq. Subjectively, I wonder how many users will actually see the difference.

In addition, this was the only machine tested that did not come with memory caching, accounting for some of the slower speeds. (Caching is available as an option.) The lack of a cache may well be off-



FACT FILE

PC Brand 386/25

PC Brand Inc.
954 W. Washington St.
Chicago, IL 60607
(800) 722-7263
(312) 226-3500

List Price: With 1MB RAM, 1.2MB 5¼-inch or 1.44MB 3½-inch floppy disk drive, \$2,450; with 40MB hard disk, monochrome monitor, DOS 3.3, \$2,990; with VGA monitor, \$3,500; with 2MB RAM, 150MB hard disk, 64MB tape backup, 80387 math coprocessor, \$5,995. Cache card, \$500; tower case, \$250.

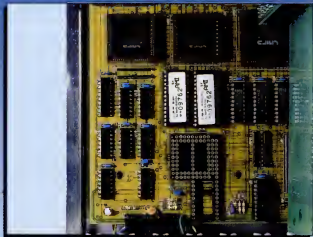
In Short: Here is an instance where choosing an off-brand computer is worth the risk. With an absurdly low base-system cost, PC Brand makes it possible to buy two complete systems for less than most competitors charge for just one. Its benchmark-test speeds were sometimes below average; you would probably do well to get the optional cache card. Even with that extra expense, this computer offers unouchable value in this market.

CIRCLE 65 ON READER SERVICE CARD

PC Brand 386/25



The PC Brand 386/25 is an unusual machine for many reasons. One is its rock-bottom price; the color VGA system with 1MB RAM and 40MB hard disk is \$3,500. The motherboard has no RAM (all RAM being relegated to a 32-bit expansion card) and saves additional real estate by overlapping the sockets for an 80287 and an 80387 math coprocessor.



set by the high performance of the 16-bit VGA adapter and the fast 15-millisecond hard disk in the tested configuration. In practice, I expect you will find this computer about as fast as any of the others included here.

From the outside, the 386/25 looks fairly typical. It has three half-height disk bay openings on the right side with another two hidden inside the case to the left. Our evaluation unit held 5¼- and a 3½-inch floppy

disk drives, as well as a 64MB Irwin tape drive. There are the standard power and disk-access indicator lights and a handy hardware reset switch.

When you open up the machine, you'll find that it's much less typical under the hood.

DISTINCTIVE ARCHITECTURE PC Brand uses its own motherboard design, which has a number of distinctive features.

SPLITTING THE BUS: THE 386 SOLUTION

The fastest PCs are using flex-bus architecture to overcome the speed limitations of the old PC bus.

When the PC was introduced, its expansion bus was a simple thing, just a means of connecting peripherals to the computer. It treated all attachments—memory, video, mass storage, and communications—the same way. The power of the PC's 8088 microprocessor, not the bus, set the overall performance limit for the system.

While this design served well in AT-class computers, 80386-based PCs quickly revealed its shortcomings. Expansion boards designed for the original PC (and even the AT) were not capable of handling the extreme speed and data throughput of an 80386 microprocessor. To maintain compatibility with these expansion boards, the operating speed of the expansion bus had to be set at a speed within their capabilities, generally the 8 MHz used by the IBM AT.

This slow expansion bus creates a major problem. If memory operated at the laggardly 8-MHz bus speed, little would be accomplished by running an 80386 microprocessor at high speeds such as 16, 20, or 25 MHz because nearly all operations that the microprocessor carries out require accessing memory. Whenever the microprocessor needed bytes from memory, it would have to slow down to access the bus. Although the microprocessor might have a 25-MHz clock, for instance, in effect it could operate only at the 8-MHz speed of the expansion bus and memory.

One way around this problem is to discard compatibility concerns and design a new high-speed bus to support

both bus and memory in a simple, PC-style direct connection. The drawback of this strategy is that it requires abandoning all existing expansion boards. For most people the cost of making the transition between standards can outweigh any speed benefits, at least in the short term.

Case in point: IBM's Micro Channel architecture. Although it was only a step toward this radical solution (the Micro Channel did alter the bus design but didn't push bus speed up to that of the highest-performance microprocessors), the Micro Channel has been slow to gain acceptance because of its incompatibility with the old PC-bus standard.

The alternative strategy is to break the bus, to split it functionally into two sections. One would operate at 8 MHz to achieve compatibility with expansion boards; the other would serve memory only and operate at the same speed as the microprocessor. All practical 80386-equipped PCs (even Micro Channel models) function this way.

In effect, these machines have two expansion buses, one for memory and one for input/output (I/O) expansion boards. In fact, many 80386-based computers provide special expansion slots, incompatible with normal PC expansion boards, that accommodate only high-speed memory. These special slots also expand the nominal 16-bit width of the PC bus to the full 32 bits used by 80386 memory.

Current cached-memory designs improve on this split-bus design scheme by allowing the operation of the two buses

separately and simultaneously. Often termed "flex-bus" architecture, such a design endows the system with two independent data pathways that can move data at the same time, helping the rest of the system to keep up with the fast microprocessor.

Typically this design is implemented by a VLSI controller such as the Intel 82385. The 82385 and other flex-bus designs allow the system microprocessor to access the memory cache while transfers are being made between the I/O bus and the main system memory.

Although two operations may occur at the same time in a flex-bus system, this approach does not allow multiprocessing or true parallel processing. One microprocessor still serves both data paths; the parallel operation of the two paths serves only to get information to that microprocessor faster.

Arbitrated-bus designs like Micro Channel architecture and the proposed Extended Industry Standard Architecture (EISA) allow several microprocessors to share the computer's memory and expansion facilities. With such designs, cached flex-bus-style architecture becomes a significant advantage. While one microprocessor is operating through the memory branch of the bus, the arbitration system can allow another microprocessor (or similar device, such as a DMA controller) to use the I/O channel. The result of all of this is true parallel processing, which can result in a quantum improvement in system performance.

—Winn L. Roach

Perhaps the most striking is that no system memory appears on the motherboard. All memory is contained on a 32-bit expansion card that sits in one of the two proprietary-design 32-bit slots. You can fit from 1MB to 8MB on a single memory card, depending on how many banks you fill and wheth-

er you use 256Kb or 1Mb chips. You can use the second 32-bit slot for more system memory or for an optional cache controller—which also accepts additional memory, so you don't limit your maximum system memory by adding the cache.

There are two 8-bit and four 16-bit full-

length expansion slots on the motherboard. On the tested unit these contained a combination serial/parallel port card, a 16-bit VGA adapter, an OMTI ESDI/MFM disk drive controller, and the interface for the Irwin tape drive. The OMTI was connected to the two floppy disk drives and a

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CIRCLE 227 ON READER SERVICE CARD

■ 25-MHz COMPUTERS

screamingly fast 150MB Miniscribe hard disk, rated at 17 milliseconds but performing closer to 15.

The motherboard sports another interesting feature: it supports both the 80287 and 80387 math coprocessors. In a space-saving move, the sockets for both types overlap (one is long, the other square). Our unit came with a 16-MHz 80387, but the difference in clock speed wasn't a problem. According to a PC Brand representative, the motherboard is designed with a

The PC Brand 386/25 is priced lower than some fast 286s that can't possibly keep pace.

PAL chip that can automatically adjust the clock timing for the coprocessor, no matter what its speed.

THE RATING GAME The CPU is a possible source of contention. The machine came with an 80386 clearly labeled as having only a 20-MHz rating. According to the PC Brand representative, the different-speed chips are made on the same production line with the same dies and are then tested for different speeds. In many ways, the situation resembles the old single-sided versus double-sided floppy disk screening process; you could often save money and successfully use the lower-rated disks. PC Brand has designed its motherboard to operate reliably at 25 MHz, and to work with the 20-MHz-rated chips.

Is this a safe approach? Well, if the CPU fails, go to PC Brand. It's willing to back the machine with a nearly unprecedented 5-year warranty. Obviously the company has confidence in the design. If you're still uneasy about it, you can opt for a 25-MHz chip at an upgrade cost of \$400.

The computer uses a new version of the

Chips and Technologies CHIPSet, which has a software program that lets you make far-reaching adjustments in the basic configuration of your system. The variables include memory mapping, the bus speeds of various slots, wait states for various components, and more. Clearly this is not for novices or for the timid, since you can create a configuration that will make your system dead as a doornail and the only way to recover is to short a pair of pins on the motherboard. On the other hand, the software gives the knowledgeable user the tools to customize the configuration for maximum performance. Configuration files can be stored and loaded from disk files, and PC Brand has prepared a number of files designed to work with a variety of popular expansion cards.

Overall, the PC Brand 386/25 is a fascinating machine. It offers flexible configurations and enough expansion options to satisfy most applications. It comes at a bargain price—lower than that of some fast 286 machines that can't possibly keep pace. And the company backs it all with what may be the longest warranty on the market. The price you pay is the computer's reliance on proprietary or less-well-known components. In the end, your decision about whether to spring for this one might be based on your level of confidence in the company, because the machine itself certainly offers an attractive value.

ZEOS INTERNATIONAL LTD.

Zeos 386-25/V

The Zeos 386-25/V is in many ways a computer typical of its class—that is, if you can safely characterize screaming speed as typical. In most cases it meets or exceeds the standards set by its competitors, from benchmark-test performance to affordability. The Zeos 386-25/V is aggressively priced, with the tested configuration listing for \$9,308.

The 386-25/V's most interesting feature is its vertical case; it's the only floor-standing model in this roundup. (Most of the other companies offer optional vertical cases or floor stands for their computers; Zeos offers a desktop model as an option.)

The case is well constructed, with cross braces at strategic locations. The top half of the case holds a stack of six half-height

drive bays, all of which can be accessed through space in the front. You don't attach rails to disk drives before installing them; the mounting screws go directly through the disk cage into the drives' sides.

The case has a power switch, a reset switch, and a turbo switch on an angled front panel, along with some indicator lights. The turbo switch is for looks only at present—it has no effect on the processor speed. You can change the CPU speed using a combination keystroke, which toggles between 8 and 25 MHz.

Inside, the computer is based on the American Megatrends motherboard, with a variety of good design features. Like many of the others, it comes with a full 64K memory cache of 25-nanosecond static RAM. Unlike most other designs, though, it can take DIP or SIMM memory, or both at the same time. You can use either 256Kb or 1Mb chips of both types. So if you use all available DIP and SIMM locations on the motherboard, you can accumulate a full 8Mb of RAM on it. The DIP sockets are also designed to accept the new 4Mb chips when they become available in quantity.

The flexible memory design on the motherboard makes it possible to get the most from the expansion slot capabilities. The proprietary 32-bit slot can accept standard 8-bit cards as well. You'll also find one regular 8-bit slot and six full-length



FACT FILE

Zeos 386-25/V

Zeos International Ltd.
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St. Paul, MN 55112
(800) 423-5891
(612) 633-4591

List Price: With 1MB RAM, 120MB hard disk, 1.2MB 5¼-inch floppy disk drive, \$6,145; with 40MB hard disk, monochrome monitor, DOS 3.3, \$5,419; with VGA monitor, \$6,114; with 157MB hard disk, 80387 math coprocessor, \$9,308.

In Short: The Zeos 386-25/V offers solid performance and a flexible design using industry-standard components, all for a competitive price.

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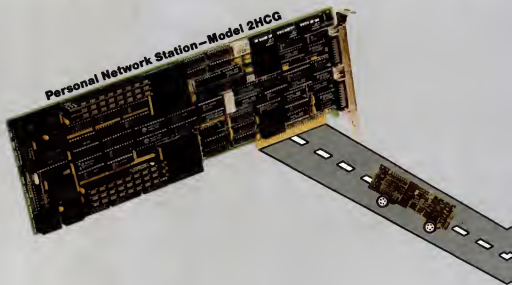
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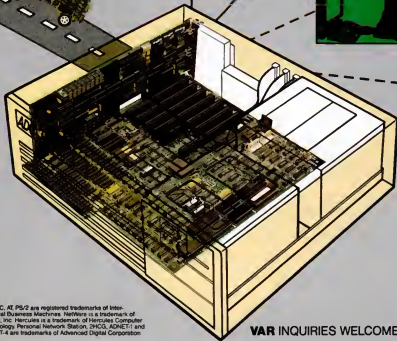
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CIRCLE 175 ON READER SERVICE CARD

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VAR INQUIRIES WELCOME

Zeos 386-25/V



The Zeos 386-25/V is the only machine in the group to come in an upright case, but it was still in the lower third in terms of the price of a VGA color system: \$6,114 including 1MB RAM and a 40MB hard disk. It offers flexible design, including room for up to 8MB RAM on the motherboard using both DIP and SIMM memory, room for six half-height storage devices, and cutouts for eight I/O connectors in the back of the case.



Eight I/O connectors

Motherboard supports 8MB RAM

Six half-height drive bays

16-bit slots. There are no I/O ports on the motherboard, but our evaluation unit came with a parallel/serial card in the 8-bit slot.

The large number of available slots makes the Zeos design attractive for a variety of applications, including network servers and multiuser operating systems. In the latter application, where a number of ASCII terminals hang off the main computer, the Zeos case provides an added advantage: there are knockouts in the back

for five 25-pin connectors and three more 9-pin connectors.

STANDARD EQUIPMENT The Zeos machine makes good use of industry-standard components. It came with an 8-bit Paradise VGA card, which performed adequately but not as fast as most of the 16-bit adapters found in other machines. It used the same Western Digital ESDI controller as four of the other computers in this

PC EDITOR'S CHOICE

• Dell System 325

More dollars don't always buy you more performance. With such a massive span between the top and bottom prices for fully configured machines in this roundup (over \$17,000), you've got to wonder where the return on your investment stops. It stops at the Dell System 325, a consistently respectable performer throughout our benchmark tests. The Dell offers some bonus design features, such as three open drive bays in the front and ports built onto the motherboard. Best of all, a VGA color system with 1MB RAM and 150MB hard disk costs only \$7,319.

If bigger brand names make you more comfortable, don't overlook the Compaq Deskpro 386/25. The company's reputation was built on machines such as this one, with careful construction, industry-renowned video, and a speedy ESDI hard disk. These advantages come at a steep price; with 1MB RAM, 60MB hard disk, and VGA display, the Deskpro 386/25 lists for a steep \$9,717.

PC Brand offers the best low-cost alternative around: the PC Brand 386/25. The configuration we tested had a 20-MHz 386 processor oscillated up to 25-MHz, but if you'd rather go for the higher rating, you'll add only \$400 to the already astounding price of \$3,500 (with 1MB RAM, 40MB hard disk, and VGA display). If less-familiar components are cause for concern, PC Brand's 30-day refund policy and generous 5-year warranty should put your mind at ease. Besides, at these prices you can buy two 386/25s, keep one in reserve on the shelf, and still spend less than you might pay for one of the competing machines.

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- AWARD Bios, one 32BIT, five 16bit, two 6bit slots

GENTECH 286-20 \$1325

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- Phoenix Bios, Norton SI 22 rating, superfast

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■ 25-MHz COMPUTERS

group, driving a 157MB Maxtor hard disk rated at less than 16 milliseconds. In PC Labs benchmark tests, this was one of the fastest drives in the group.

In the other benchmark tests, the 386-25/V delivered results that were usually a bit better than average. Since most of the other machines excelled in some tests while producing slower times on others, I expect that they would all appear about the same for real applications. The Zeos hard disk speed might give it a slight edge, however, in disk-intensive use.

The 386-25/V sported a variety of

**The Zeos 386-25/V
falls right into the
middle of the pack
in most respects.**

handy extras, such as the keyboard and monitor extension cables required to reach the system unit when it is standing on the floor.

The Zeos falls right into the middle of the pack in most respects. Its performance is essentially on a par with the others. It is well constructed—not as sturdily as some of the more expensive machines but better than some of the cheaper ones. Zeos is not a widely known manufacturer, but the computer uses the same standard components found in many of the others, such as the AMI BIOS, Western Digital controller, and Paradise VGA. Even its price places it in about the middle of the field. Only its case visibly rises above the competition.

In the end, the Zeos makes a good compromise choice, midpoint between the top and the bottom of the list. Its features and price represent a good value; you won't be making a mistake if you select this one. ☐

Alfred Poor is a microcomputer consultant based in Perkasie, Pennsylvania. He is a frequent contributor to PC Magazine.

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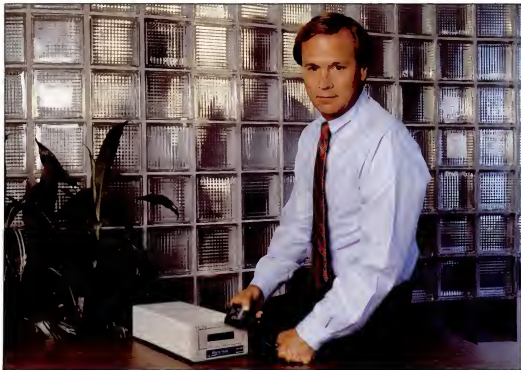
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GETTING THE MOST OUT OF MEMORY

*Disk-caching software can
cut your time at the computer
by an impressive margin.*



Disk-caching software is based on three principles: if you need to refer to a certain piece of information once, you'll probably need to do so again; remembering information is more efficient than looking it up time and again; and it helps to know related information in addition to the information itself.

A disk cache takes these three principles and applies them to the disks and memory in your computer in order to speed up every operation in which data is transferred to or from a disk. A well-designed cache can reduce the time DOS takes to read and write to a hard disk by a factor of ten. With floppy disks, a cache can enhance disk speed by as much as 50 times its normal rate. And all of this is accomplished without making any physical change to the disk hardware.

If you work mostly with programs like word processors and spreadsheets that seldom read the disk, a cache won't significantly speed up your work, but it is still worth having if only for the good feeling you'll get when the program loads in a fraction of its usual time. If you use a database or any other software that continually reads the disk, however, a cache can cut your time at the computer by an impressive margin.

Whenever an application needs data, it asks DOS to find it on your disk. DOS then reads the disk (via the BIOS) and hands the data over to the application. But if you're using a disk cache, the cache insinuates itself as a middleman in this transaction. As DOS reads data from the disk, the cache whisks away a copy of the data for itself and stores it in an area of memory that it re-

■ DISK-CACHING SOFTWARE

serves specifically for that purpose.

The next time an application makes a request for data, the cache intercepts the request and checks its storage area to see if the data is already there. Because most applications need to consult the same data or the same files more than once, the chances are reasonably good that the cache will already have a copy. Even if the data that the application wants this time around is not exactly the same as the data it requested earlier, the new data may well be in a region of the disk that DOS had read before when looking for nearby data. In that case, the cache already has a copy of the data in its storehouse. The cache checks its inventory, finds the data, and hands it over to DOS. DOS then passes it to the application, which doesn't care in the least whether the data came from memory or a disk.

TIME IS CACHE But if you're as impatient as every other computer user, you care. The cache saves precious time by producing data from fast RAM instead of from a slow disk drive. You don't have to wait while the drive heads jump to the right place on the disk and hover there until the data spins into the right position. The cache simply moves some electrons.

If the requested data isn't in the storage area, the cache hands the request back to DOS and lets DOS haul it away from the disk. But once again, when DOS delivers data to the application, the cache keeps a copy for itself. And when the application asks DOS to write altered data back to the disk, all currently available cache programs step in and demand a copy for themselves.

In fact, cache programs tend to be very greedy. Even if an application wants only 64 bytes of data, the cache swallows up at least 512 bytes—the size of one of the sectors into which DOS divides up data on a disk. Usually the cache prefers to gobble up a lot more than 512 bytes. Instead of taking one sector, it will take four or more, sometimes the full 17 sectors on the track of a standard hard disk. The cache guesses that the application is eventually going to want more data from the same file, and that the new data is likely to be found in the neighborhood of the data the application wanted before.

In general, the greedier the cache, the

more generous it can be in the long run. The more data it grabs, the more it can hand over to DOS. And the more data it presents to DOS, the less time DOS has to spend in trudging to and from the disk.

THEORY INTO PRACTICE That's the basic theory of disk caching. In practice, of course, everything is more complicated. If a cache keeps a badly organized catalog of its storage area, your applications can actually be hindered by caching rather than helped. By the time the cache finishes rummaging in its catalog for the location in the storage area where it is holding some data, DOS could have gone directly to the disk and found the data on its own.

■ No matter how well organized a cache is, it must work within DOS's 640K RAM limit to leave space for other uses.

A cache needs to maintain a tightly organized catalog that helps it find data quickly. Let's say your disk is a standard 32MB hard disk with 64,000 sectors and you use a 256K cache with room to store data from 500 sectors. When DOS asks for data from sector 7000, the cache shouldn't waste time flipping through all 500 of its catalog entries just to see if it can find a listing for sector 7000. It should be able to jump quickly to a narrow area of its list to see whether sector 7000 is in storage. The cache doesn't have room for a catalog with separate slots for all 64,000 disk sectors, so it finds another way of maintaining an accurate summary of its contents.

One method is to store and index data in blocks the size of disk tracks rather than in individual sectors. A disk with 64,000 sectors has about 3,800 tracks, and these are a lot easier to index than the sectors themselves. But this is only one of many complex methods that cache software uses to save space and time. (For more information on these methods, see "Speed Up

Hard Disks with DCACHE," *PC Magazine*, October 11, 1988.)

No matter how well organized a cache is, it has to work within the limits of DOS's 640K of RAM. DOS needs some of that space to perform its own housekeeping, and your applications need much of the rest. That doesn't leave a lot of room for a disk cache and its catalog. If a cache is too small, it won't be able to hold enough data to give DOS the information it needs, and it will spend too much time replacing old data with new data to build up the kind of inventory needed to make a cache worthwhile in the first place.

The advent of extended memory in 80286 and 80386 computers and Lotus/Intel/Microsoft expanded memory specification on any computer gave disk caches some extra elbow room. A cache can now keep its storage area (or "cache buffer") in extended or expanded memory and occupy only as much DOS memory as it needs for the code that processes data and its catalog. This catalog is called the "cache directory" or "lookup tables." Some caches can even keep their tables in expanded or extended memory, further reducing the amount of DOS memory needed for the cache.

Even a large cache is a lot smaller than a hard disk. Sooner or later during a computer session, the cache buffers will fill to overflowing, and the cache will have to decide which old data to throw overboard in order to make room for new data. Almost all caches use a Least Recently Used algorithm to make this decision. The cache directory keeps track of the last time DOS asked for data in each sector. When it needs room for a new sector, it scans the cache directory, finds the sector that DOS asked for least recently, and discards it. The data in the discarded sector is safe on disk, and if DOS asks for it again, the cache will discard another sector and welcome it back.

POPULARITY CONTEST The most sophisticated caches combine the Least Recently Used algorithm with a slightly different one: Least Frequently Used. In effect, the cache makes each sector undergo a complex popularity contest to determine how long it can remain in the cache buffer.

If DOS made frequent requests for a sector early in a session but later stopped asking for it, the sector can coast on its initial popularity and stay in the cache even after it becomes the sector least recently used. More recently used sectors will be dropped first if those other sectors never racked up enough frequency-of-use points. Sooner or later, however, newly popular sectors will elbow the once-popular sector into the cold.

In the world of a disk cache, every sector can be famous for 15 minutes. When DOS asks for data, a sector immediately enters the cache. But if DOS asks for that sector only once, its ranking will drop rapidly, and soon it too will be waiting outside in the rain with all those other wretched sectors that the doorman treats with undisguised disdain.

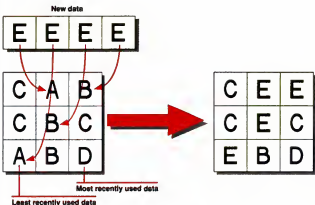
One elite group of sectors never stops being popular. DOS constantly needs to consult the sectors that contain your disk's directories and FAT (file allocation table) in order to learn where to locate files. A sophisticated cache can give the sectors enough extra points to ensure that they remain in the cache no matter how many other sectors are clamoring to get in.

FASTER READS AND WRITES All caches treat disk reads in a more or less similar way. Although some caches are more efficient than others at scooping up groups of sectors, the basic techniques they use tend to be the same. But all caches treat disk writes differently. Most caches speed up disk writes by checking whether the data that DOS sends to the disk matches data written earlier and by refusing to write the same data twice. The best caches use additional techniques to make all necessary disk writes take the least amount of time. Some caches queue or sort data destined for the disk so that DOS can write all the data in a single rotation of the disk or with the least possible movement of the heads. Some effectively multitask disk writes and other computer activity so that the cache continues to write to disk while you get back to work on your applications.

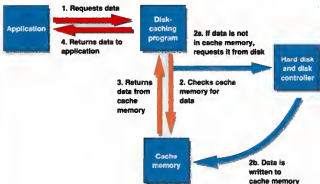
These programs do their best to get the data to disk quickly. Others hold the data in memory for a longer period and won't write to disk until the computer is not occupied with anything else. One program



How Disk Caching Works



When new data (represented by the blocks labeled E) is introduced to the cache, the least recently used (LRU) data is discarded first.



Cache programs sit between your application and the disk controller. When the application requests data that is on the disk, the cache program checks to see if it is already in cache memory. If it is, the cache program retrieves the data from memory instead of from the disk. If it is not in cache memory, the program gets the data from disk, writes it to cache memory for possible future use, and returns it to the application.

CHOOSING THE RIGHT CACHE

Deciding which type of memory and the best cache size to use is mostly a matter of trial and error.

The first decision you must make when setting up your cache is which type of memory to use—conventional, expanded, or extended. If you use only applications that run in substantially less than 640K, then conventional memory caching makes sense. You'll see faster results with a conventional memory cache than you will with an expanded or extended memory cache of the same size, since using expanded or extended memory exacts a performance penalty.

Usually, however, you will want to put your cache in extended or expanded memory, allowing your applications to best use that precious 640K of base memory. Even doing so, you will still need some conventional memory to run the caching program; the amount varies greatly depending on the program you're using and the settings you've chosen. Typically, disk-caching programs occupy less than 64K, with many packages using substantially less.

If you have both extended and expanded memory, you must carefully consider the type of work that you do and how well your caching program performs in both modes before choosing between them. With each access to extended memory, your PC must switch into and out of protected mode. As a result, each access is slower than an equivalent conventional or expanded RAM access. Thus you're likely to realize poorer caching performance in extended than expanded memory, with the gap widening as the number of discrete memory accesses increases.

In general, if you have both types of memory to choose from, you will usually want to set up your cache in expanded memory. Still, you should check the performance of your caching software in both modes. We found that at least one program, *Flash*, performed more slowly when using expanded memory. With Su-

per PC-Kwik, we found another reason to choose expanded memory. *Super PC-Kwik* requires expanded memory for some of its program space, reducing the conventional memory needed by about half, to 16K. Disable a feature or two, and you can get it down to a mere 9K.

THE IMPOSSIBLE DREAM Can you define an optimal cache size? Not really. The efficiency of the cache size depends on the typical operations you'll be performing, the amount of memory available, and the memory type you are using. If you are using conventional memory, you must balance the benefits of a larger cache against the handicap of having less conventional memory available for applications. If you are using expanded or extended memory, your limitations are almost nil.

Many caching packages allow unloading and loading from the command line, which means that you can reconfigure the cache for different applications. But remember that you're using caching software to save time. If you spend a lot of time reconfiguring and reloading your caching software for each application, you will negate much of the benefit of fine-tuning. In the end, you are best off choosing a single configuration and forgetting about it.

CACHE SIZE The biggest question for conventional memory caching is how small the cache can be. A 64K conventional memory cache will have some benefits but will have minimal impact on available memory. A small cache will do the job with operations that involve small, discrete chunks of data that are referred to often, such as database sorting and the loading of the FAT when working in DOS.

With extended or expanded memory, you will probably have more memory to

play with. A large cache will help a word processor that loads only pieces of a large document at a time. It can also help dramatically by storing applications themselves in the cache. If you are using a program like *WordStar* that swaps pieces of itself in and out of memory, or if you constantly go back and forth between several small programs, like an editor and a compiler, then a large cache can substantially reduce waiting time. Caching won't help *Lotus 1-2-3* handle large spreadsheets, since it loads the spreadsheet totally into memory.

As you increase the cache size, the greatest improvements in performance typically come before 256K. Between 256K and 512K, the application will determine how well the additional memory will be used. Above that point, more memory will probably enhance performance, but the gains are small compared with the price in memory chips.

Caching programs handle different cache sizes with varying degrees of sophistication. The best way to test your cache program is to experiment with your applications, reducing cache size incrementally until it is low enough to cause a substantial degradation in performance. Make sure that you try this method with your everyday applications, since the results for one type of application may not be applicable to another. If your caching software allows you to examine the cache activity, use this feature to check the impact of configuration changes. If you often work with large records, such as word processing documents, then a cache bigger than the application plus your largest file will give better performance. If most of your work is with small records, such as database files, then a small cache will improve performance to make using it worthwhile. And, despite many of these recommendations, bigger is almost always better.—Philip F. H. Rose

Philip F. H. Rose is a project leader in PC Labs.

waits as long as 5 minutes before writing by default and even lets you choose to delay writing until you give the cache a specific command to copy its buffer to the disk. "Deferred writes" like these are standard procedure on mainframes, but they're of questionable value on a PC. If an application thinks it has written data to the disk but crashes before the data actually gets written, your work will disappear into the great cache buffer in the sky, from whose bourn no data returns.

Disk caches have little trouble keeping track of data on a hard disk. Floppy disks and other removable media present a more difficult problem. Some caches cannot be used with removable hard disks or cartridge disks like the Bernoulli box. But even standard floppy disks entail a slight degree of danger. If a cache stores the FAT and directory of one floppy disk and then doesn't notice that you've pulled the first floppy out of the drive and replaced it with another, it can shatter the data on the second floppy beyond repair when it thinks it is writing to the first.

All current caches check whether the floppy disk in the drive has been changed. Some rely on the "diskchange" detection built into ATs and compatibles, but all can supplement it with other tests, which are necessary on all PC and XT systems. A cache that uses deferred writes may pop a warning onto the screen if you change disks before the cache has had a chance to send data to the first disk, but you're much better off not using deferred writes with floppy disks at all.

PROTECT YOUR DATA Any program that interferes with DOS's orderly habits of reading and writing to disk has the potential to be highly dangerous to your data. All the caches tested for this article have been available for months or years, and any serious problems would have become evident long ago. You can probably use any of these programs without any hesitation. But if there is anything at all out of the ordinary about your computer system, you should take certain precautions when installing a cache. This applies if you have a nonstandard disk or one that requires a device driver in your CONFIG.SYS file; it applies if you have an 80386 system and you use memory managers to install TSRs

in high memory; it applies if you have an AT compatible with separate controller cards for floppy and hard disks. And it applies if you have a plain-vanilla PC but value your data highly.

Your precautions should go something like this: Until you make a complete, reliable backup of your hard disk, keep all cache software a safe distance from your computer—50 yards is probably about right. When everything is backed up, install the cache according to the vendor's instructions, but if the cache includes any advanced options for high performance, turn them all off, even if some of them are default settings for the program. With the cache loaded, copy files between directories and between your hard disk and a series of floppies. Delete some files. Run CHKDSK on every disk you use. Reboot the computer without the cache and run CHKDSK a second time on every disk you used before.

Next, reload the cache with some of the advanced options switched on, and run the same series of tests. Only when you are certain that the cache leaves your data intact should you resume your normal work at the computer.

Don't get complacent and run a disk defragmenter with a cache in memory. The combination of a defrager and a cache can turn your disk into electronic confetti. The very best caches are smart enough not to be confused by defraggers, but you should have a complete backup (or two or three) before you find out whether your cache is one of the best.

ABAKER'S DOZEN For this article, PC Labs tested 13 cache programs. Seven of these are separate cache packages, which sometimes include related programs on the same disk. These are *Fast Forward*, *Flash*, *Lightning*, *QuickCache II*, *Super PC-Kwik*, *Vcache*, and the freeware program *EMMCACHE*. Three cache programs are sold as part of disk utility packages: the *Mace Utilities*, *PC Tools Deluxe*, and *PolyBoost II*. Two caches are available only on the installation disks that come with Compaq and IBM computers: the *Compaq Disk-Cache Utility* and *IBMCACHE*. Finally, *Microsoft Windows* includes a cache of its own, *SMARTDrive*.

PC Labs obtained a few other caches

but didn't include them in the tests because they proved incompatible with DOS 3.3. Micro Design's *Cache/Assist* produced disk errors when run under any version of DOS later than DOS 3.1. MicroWay's *Dcache* locks up under anything later than DOS 3.2. The freeware program *CACHE2*, available on almost any bulletin board, locked up the computer and scrambled the disk when we tried to test it under DOS 3.3. The obvious lesson: back up your disk before running any cache under a new version of DOS.

You should also back up your disk before running a cache under an old version. The README file included with one cache program warns against running any cache software under Zenith MS-DOS 3.1.

One more problem to watch out for before moving on to the reviews. If you install a cache in extended memory, you can lose characters transmitted via high-speed communications software. The best caches include methods of avoiding this problem, and the problem does not occur at all if you install the cache in LIM expanded memory.

Whichever cache you use, the time you spend in taking precautions will be returned to you many times over by the cache itself.

Compaq Disk-Cache Utility

There are many less expensive ways of getting a disk-caching program than buying a computer that comes with one, but if you want the *Compaq Disk-Cache Utility*, you'll have to do just that. There are also many alternatives that are a lot better in terms of overall performance. Still, you won't regret installing the *Compaq Disk-Cache Utility* each time you use your new machine.

Anything IBM can do, Compaq tries to do better, and the *Compaq Disk-Cache Utility* is no exception. Where IBM offers the lumberingly slow *IBMCACHE* on its PS/2 models, all Compaq desktop and portable computers that are shipped with a hard disk come with a cache that sets one or two speed records and has a useful but limited range of options. In extended

■ DISK-CACHING SOFTWARE

memory, Compaq's cache outperforms even *Super PC-Kwik* in the 512K file creation benchmark. In other tests, Compaq's cache is far better than no cache at all, but compared with the best cache programs its results are uninspiring. Like *IBMCACHE*, the *Compaq Disk-Cache Utility* speeds up only standard hard disks. It ignores floppies and any disks that DOS can recognize only through a device driver.

The *Compaq Disk-Cache Utility* distinguishes itself by its efficient use of disk and memory space. You install it as a device driver in your *CONFIG.SYS* file, but because the driver is also an .EXE file, the same program that installs the cache controls it from the DOS command line. All

other caches installed through *CONFIG.SYS* use separate control programs or none at all. Install a 512K cache buffer in LIM expanded memory, and the cache occupies either 15K or an impressively small 8K of DOS memory. (You can use the LIM memory installed on AT-style memory boards or, on 386 machines, the LIM-emulation memory created by Compaq's CEMM memory manager.) When you install a 512K buffer in AT extended memory, you take away 27K or 16K from DOS, depending on options.

BAFFLING OPTIONS Compaq's installation disk uses a moderately confusing menu system. A set of options on a top line

menu offers choices like Configure, Exit, and Help. But you can't seem to get to these choices with the cursor keys, and pressing the first letter of each doesn't accomplish anything. After a frustrating moment or two, you'll notice another menu on the bottom line that tells you to press F10 for Functions. This finally lets you use the cursor keys or first letters for the menu at the top.

If you choose Configure, you'll be offered a menu that lets you select a cache buffer in AT extended, LIM expanded, or conventional DOS memory. Whichever you choose, you're limited to a range of 128K to 512K as a buffer size. You can choose whether to enable queued disk



Disk-Caching Software: Summary of Features

(Products listed in ascending price order)

	Compaq Disk Cache Utility	EMMCACHE	IBMCACHE	SMARTDrive	Quickcache II	Vcache	Fast Forward
List price	Included with all models that ship with a hard disk	Free	Included with all PS-2 models	Included with Windows 286 and Windows 386	\$59.00	\$59.95	\$69.95
Cache size (minimum-maximum)							
Conventional memory	128K-512K	N/A	16K-512K	N/A	20K Limited by DOS	16K-500K	60K Limited by DOS
Extended memory	128K-512K	N/A	16K-15MB	128K-4MB	20K-1.7MB	16K-8MB	1MB
Expanded memory	128K-512K	16K-8MB	N/A	128K-4MB	20K-1.7MB	16K-15MB	1MB
Extended memory overhead	16K	N/A	14K	14K	42K	20K	58K
Expanded memory overhead	8K	7K	N/A	14K	42K	19K	58K
Caches floppy disks	☐	☐	☐	☐	●	●	●
Caches Bernoulli Box	☐	☐	☐	☐	●	●	☐
Enables and disables installed cache	●	●	☐	☐	●	☐	●
Flushes cache buffers without uninstalling program	●	☐	☐	☐	●	☐	●
Is installable without rebooting	●	☐	●	●	☐	☐	●
Lets user specify drives to be cached	☐	☐	☐	☐	●	●	●
Saves writes in cache	●	●	●	●	●	●	●
Queues writes before writing	●	☐	☐	☐	●	●	●
Has write-by-command-only option	☐	☐	☐	☐	☐	☐	●
Has full-track read option	☐	☐	☐	☐	●	●	☐
Allows files to be locked in cache	☐	☐	☐	☐	●	☐	☐
Displays cache status settings	●	●	☐	☐	●	●	●
Displays cache performance statistics	●	☐	☐	☐	●	●	☐
Has automated installation procedure	●	☐	●	●	●	☐	●

☐—Editor's Choice ●—Yes ☐—No N/A—Not applicable; the program does not operate in this kind of memory.

writes; when disk writes are queued, single-sector disk writes are gathered into a buffer before being written to disk. And you can choose whether to have the cache turned on at bootup.

If these options seem baffling, you can pop up a context-sensitive help screen or call up a more extensive file of tutorial help. Seventeen screens are available that detail how to set up and control the cache. When you're finished with setup, the installation program adds a command line to CONFIG.SYS and you can reboot to start using the cache.

Once the cache is loaded, you can enter CACHE at the DOS command line to display a screen of statistics and a list of the

current settings. If you add parameters to the CACHE command, you can clear, disable, or enable the cache, and turn queued writes on and off. If you enter CACHE and the cache is not loaded, you are shown a screen with the correct syntax for adding the cache to CONFIG.SYS.

EFFICIENT YET LIMITED Compaq's use of a single file for all cache functions is a sign of efficiency of imagination, so it is mildly surprising to find that the cache allows so limited a range of memory sizes. If you load the cache in conventional memory, the minimum buffer size of 128K is too large to let many DOS applications fit comfortably into the remaining space. And



FACT FILE

Compaq Disk-Cache Utility

Compaq Computer Corp.

20555 FM 149

Houston, TX 77070

(713) 370-0670

List Price: Included with any Compaq desktop or portable computer that ships with a hard disk.

Requires: 64K RAM, DOS 3.31 or later.

In Short: A middle-of-the-road cache that offers a useful but limited range of options and memory sizes. Distinguishes itself by its efficient use of disk and memory space. Not copy protected.

CIRCLE 666 ON READER SERVICE CARD

Flash	PC Tools Deluxe	PolyBoost II	Super PC-Kwik	Lightning	Make Utilities
\$69.95	\$79.00	\$79.95	\$79.95	\$89.95	\$99.00; Gold Version, \$149.00
5K Limited by DOS	64K/512K	5K/500K	64K/512K	20K Limited by DOS	64K/384K
5K/32MB	64K/16MB	5K/5MB	64K/16MB	N/A	64K/16MB
5K/32MB	64K/16MB	5K/5MB	64K/16MB	20K/1.8MB	64K/8MB
25K	20K	12K	16K	N/A	10K
25K	16K	11K	7K	23K	9K
●	●	●	●	●	○
●	○	○	●	●	○
●	○	●	●	●	●
●	●	●	●	●	○
○	○	○	○	○	●
●	●	●	●	●	●
●	○	○	○	○	○
○	○	○	○	○	○
●	○	○	○	○	○
●	○	○	○	○	○
●	●	●	●	●	○
●	●	●	●	●	○
●	●	●	●	○	○

if you have a lot of extended or expanded memory available, the 512K maximum is too small to be useful with some large applications and databases.

Some Compaq utilities work with only Compaq computers, but the *Compaq Disk-Cache Utility* can be used on almost any machine—although queued writes are not available on 8088 or 8086 machines. No special synergism makes the Compaq cache work especially well with Compaq computers. When PC Labs compared the performance of the Compaq cache and *Super PC-Kwik* on a Compaq 386/20, *Super PC-Kwik* performed twice as well.

EMMCACHE

Here's a disk cache that costs you a few cents' worth of telephone connection time to your local BBS, takes up a tiny amount of DOS memory, and speeds up disk reads at a rate equal to the best commercial cache programs. It runs only in LIM expanded memory, but it takes advantage of LIM memory in ways that few other caches even imagine.

EMMCACHE is the work of Frank Lozier, a mathematician at a midwestern university. It's copyrighted but free of charge. Don't punish the generous author by besieging him with requests for a copy; get one from the disk library of a local user group, or from a reliable BBS, or from an on-line service like PC MagNet or Compu-Serve.

When you've got **EMMCACHE** on your disk, you'll find that it consists of an **EMC110.COM** file and a couple of text files. Install the cache by entering a line like this at the DOS command line:

```
emc110 32 16
```

The first parameter is the maximum size of the cache as measured in expanded memory pages of 16K each; 32 pages will create a cache of 512K. If you don't specify a size, the cache will occupy all available expanded memory up to a limit of 8MB. The second parameter, which is strictly optional and generally unnecessary, is the minimum number of expanded memory pages in the cache. The only reason to specify a minimum is to prevent yourself from creating a cache that is too small to be of any use. If your expanded memory is already occupied to the point where the specified minimum isn't available, **EMMCACHE** will refuse to install.

After you enter the command to create the cache, there's a relatively long pause while the program checks out available memory and creates its lookup tables. A message then appears reporting the size of the cache, and you're ready to roll.

RELEASING EXPANDED MEMORY

Whenever you're at the DOS command line, you can change the size of the cache to release expanded memory for other programs. Because the cache took over a fixed amount of DOS memory on installation for its lookup tables, you can't increase the size of the cache above the maximum size you specified at first. But you can reduce the amount of expanded memo-

ry used by the cache buffers and later increase it up to the initial maximum. You can also disable or enable the cache or remove it entirely from memory.

EMMCACHE caches reads and writes, but it doesn't queue or sort disk writes. It includes support for multitrack disk reads made possible under DOS 3.3 and later. It won't cache floppy disks. In PC Labs benchmark tests, it speeded disk writes just to a moderate degree, but its disk reads were either tied for first place or only slightly behind.

SPEED AND SAFETY EMMCACHE

gives you speed without sacrificing safety. As long as you are certain that you are not using nonstandard disks like Bernoulli cartridges or any other disk that requires a device driver in **CONFIG.SYS**, **EMMCACHE** will deliver reliable and invisible service. It responds to any error condition by clearing out anything in the cache that might be associated with the error—or the entire contents of the cache.

The most recent version of **EMMCACHE**, Version 1.10, has been circulating on BBSes for about 18 months. Thousands of copies are probably in use by now, and any problem would long since have been reported. If you obtain a copy of **EMMCACHE** from a reliable BBS or an on-line service, you'll have a cache that's safe, effective, and free.

Fast Forward

Some software makes you look in the mirror and decide who you really are.

If you're absolutely fearless and have nerves of steel, **Fast Forward** may be the cache for you. The Mark Williams Co.'s \$69.95 program performed fairly well in the file-reading section of the PC Labs benchmark tests and without distinction in all the other tests. But if you use **Fast Forward** as a benchmark test of your own confidence and powers of concentration, you'll find there's nothing to match it.

In its default configuration **Fast Forward** doesn't write data to disk when DOS or an application program wants to do so. Instead it stores the data destined for the disk and writes it later—up to 5 minutes later, if your machine is busy with other tasks. If it doesn't make you nervous to



Benchmark Tests: Disk-Caching Software

A disk-caching program should speed up repeated disk accesses to the same data, by storing the data in a cache buffer and referring to the buffer rather than the disk when an application makes requests. Because of the additional writing to the cache buffer, however, caching introduces some overhead to each data access. Typically, the benefits of caching outweigh this overhead, but if the cache is too small to contain the data records, or if there are few records, then performance can suffer.

That explains why, running our large-record test with a 64K cache, all but two of the programs we tested turned in performance times that were slower than using no cache at all, even those two did not help performance. Because they do not buffer writes, **IBMCACHE**, **EMMCACHE**, **Fast Forward**, **SMARTDrive**, and **Mace Utilities** were among the slowest in terms of overall performance. If we had measured reading performance alone, **EMMCACHE**, **SMARTDrive**, and **Mace Utilities** would have fared much better.

Fast Forward and **Mace Utilities** did not improve performance in our small-record test with a 64K cache. These two programs, as well as **IBMCACHE**, **Quickcache II**, and **Compag Disk-Cache Utility**, didn't help much when tested with other memory configurations and large records. Although the mediocre results for these five programs in the large-record tests look similar, **Quickcache II**, **Fast Forward**, and **Mace Utilities** performed large-record writes slower than using no cache at all, but they had adequate reading speeds. (**IBMCACHE** and **Compag Disk-Cache Utility**, by contrast, do not degrade performance in reading or writing.) If your caching chores will deal mostly with large records and involve a fair amount of writing, then packages like **Quickcache II**, **Fast Forward**, and **Mace Utilities** will not improve and might even degrade performance.

Although **Super PC-Kwik** was the top performer overall, that ranking is partly due to its lightning-fast speed at creating files. In fact, **PolyBoost II** was the fastest by a hair at both reading and writing, but was much slower at creating files than most of the other programs we tested. **Super PC-Kwik**'s file-creation times aside, the six fastest programs turned in similar performance times. Among these packages, considerations other than raw speed may be more important.



FACT FILE

EMMCACHE

Frank Lovier

Available from bulletin board systems, PC MagNet, and CompuServe.

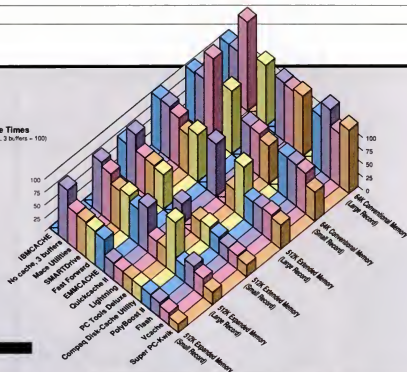
List Price: Free

Requires: LIM expanded memory.

In Short: This compact cache works only in expanded memory. Although it speeds disk writes just moderately, its disk reads were among the fastest tested. Not copy protected.

CIRCLE 640 ON READER SERVICE CARD

Relative Times
(No cache, 3 buffers = 100)



DOS File Access

Performance Times
(Times given in seconds)

	512K Expanded Memory		512K Extended Memory		64K Conventional Memory	
	Small Record	Large Record	Small Record	Large Record	Small Record	Large Record
IBMCACHE	NA*	NA*	49.53	18.81	69.53	18.89
No cache, 3 buffers	72.11	18.96	72.11	18.96	72.11	18.96
Mace Utilities	49.61	17.52	50.53	17.61	110.26	32.22
SMARTDrive	48.60	13.97	49.86	14.13	NA*	NA*
Fast Forward	46.47	14.93	47.84	16.98	85.87	21.87
EMMCACHE	44.88	12.72	NA*	NA*	NA*	NA*
QuickCache II	23.47	16.00	27.77	19.01	58.46	20.96
Lightning	22.00	6.54	NA*	NA*	58.49	20.70
PC Tools Deluxe	21.68	6.95	24.63	7.91	52.21	21.57
Compaq Disk-Cache Utility	21.49	18.77	26.80	18.74	NA**	NA**
PolyBoost II	21.26	5.80	23.37	8.81	56.93	19.58
Flash	20.14	8.38	19.21	9.12	56.88	24.87
Vcache	16.49	6.67	18.68	9.51	55.80	18.96
Super PC-Kwik	11.63	4.45	16.49	8.64	40.21	22.94

NA*—Not applicable: the program cannot be run in this kind of memory.
NA**—Not applicable: the program cannot use a 64K cache.

PC Labs tested the disk-caching programs on an 8 MHz IBM PC AT with a 30MB hard disk, 640K RAM of conventional memory, and a 4MB Intel Above Board configured with 2MB of expanded memory and 2MB of extended memory. We kept all program files in one partition on the hard disk and used a separate 10MB partition for the test files.

We ran the DOS File Access benchmark tests using three different caching software configurations, when available: 512K of expanded memory, 512K of extended

memory, and 64K of conventional memory. We reformatted the disk partition used for test files after running each set of tests.

Many disk caching programs allow advanced features to be turned off for improved compatibility or for RAM size reduction. We tested the programs using the fastest combination of features possible.

The DOS File Access benchmark test measures the throughput rate of the disk being tested. In this case, throughput times are measured in terms of how long the

disk takes to perform common DOS file-management functions: Five tasks—file creation, sequential file write, sequential file read, random file write, and random file read—are timed and the results summed.

The test is carried out for two different types of files—small-record files and large-record files—that are used by common PC applications. Files created using small records are typically used by database management programs, and large records are typically used for word processing and spreadsheet files. Loading a DOS program is also simulated by the large-record test.

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making backups
please raise
their hand.



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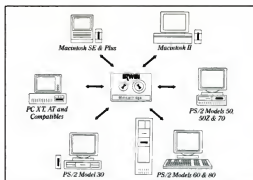
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CIRCLE 219 ON READER SERVICE CARD



FACT FILE



Fast Forward,
Version 1.1.6
Mark Williams Co.
601 N. Skokie Hwy.
Lake Bluff, IL 60044
(312) 689-2300
List Price: \$69.95
Requires: 512K RAM;
DOS 2.0 or later
In Short: A slow, RAM-consuming cache
program with some rough edges. The default
setting delays disk writes up to 5 minutes—
too long for comfort. Not copy protected.

CIRCLE 648 ON READER SERVICE CARD

think of all that data floating precariously in memory—data that will be lost forever if your application program locks up or if you suddenly decide to turn off your computer—you have stronger nerves than I do.

RISKY BUSINESS If your nerves are strong enough for disk writes delayed up to 5 minutes, then you might consider an even riskier option. *Fast Forward* lets you choose to store data in memory indefinitely and never write to disk at all until you issue an explicit command. Your work will be lost forever if you don't save to disk before you turn off your computer. The manual wisely suggests that if you use this option, you should get into the habit of saving at regular intervals.

Fortunately, *Fast Forward* has a write-through option that saves immediately to disk, and the program makes this option the default for floppy disk drives. You can also change the maximum delay for the delayed-write option.

As you can imagine, *Fast Forward* is emphatically not designed to be installed and forgotten. You would be wise to keep thinking about it at every moment when you work. To save to disk, or alter any options, you press a hotkey and scan a menu of commands that let you save data to one or all disks, or disable or unload the cache, or switch between the options that let you save data to memory or to disk or to the delayed-write buffer. The same menu contains brief descriptions of each option and lets you know whether any unsaved data is

still lurking in RAM. The same commands on the menu can be run from the DOS command line, so you can write a batch file that loads an application and then saves your work to disk when you exit.

You can load *Fast Forward's* cache in conventional, expanded, or extended memory. A 512K cache in either expanded or extended memory makes you give up 58K of DOS memory. *Fast Forward* caches only standard disks, not Bernoulli Boxes or anything else that uses a device driver.

UNSETTLING QUESTIONS *Fast Forward's* installation program modifies the executable file to match the memory and disk options you select. You don't need to use command-line switches or parameters when you run the program afterward. The install routine asks a series of questions, some of them mildly unsettling. For example, it asks you to report whether each of your disks is a floppy or hard disk—something that you might expect the cache to be able to figure out for itself.

The default hotkey that pops up the menu is Ctrl-Right Shift-Keypad 5. You're reminded of this combination when the program loads. But if you change the hotkey during installation, the program won't remind you which key you chose. If you forget your hotkey, the manual suggests that you run the installation program and choose another.

If your computer has both expanded and extended memory and you tell the installation program that you don't want to use expanded memory, it asks you if you want to use AT extended memory. But when it asks this question, it scrambles the screen so that the question appears half outside the menu, and part of the menu border moves to the middle of the screen. Attention to detail matters a lot in programs that work as intimately with your disk as caches do, so this detail may not inspire confidence. The files on the review copy of the disk dated back to October 1987. Didn't anyone notice that something was wrong?

Flash

Flash comes with so many options and switches that I half-expected to find a pa-

rameter that would let me transform my PC into a mainframe or a Mac. I never found it, but it may be listed deep in the README file, along with the rest of the cornucopia of choices that Software Masters keeps pouring into its fast, powerful, and highly configurable \$69.95 cache.

In the PC Labs benchmark tests, *Flash* finished fourth in overall times. It produced some spectacularly high scores in sequential reads and performed consistently well in most other benchmarks. If you have AT extended memory but no LIM extended memory, *Flash* may be one of your best choices because it includes features that make extended memory as safe and efficient as LIM memory. Unlike other caches, *Flash* gives its best performance in extended rather than in LIM memory.

But *Flash* isn't choosy about the kind of disk it works with. Software Masters' motto seems to be "If it spins, cache it." You can cache up to 26 drives, including Bernoulli boxes and other installed devices, and hard disks of up to 545MB with sector sizes of up to 8K. The program can decide on the fly whether to cache whole tracks or only a few clusters, and it uses proprietary techniques to sort and queue disk writes to reduce head motion and save time.

LOTS OF OPTIONS No other cache gives you nearly as many options as *Flash* does. You can set up *Flash's* buffers in conventional memory, LIM expanded memory, AT extended memory, on a RAMdisk, or even in the memory that in



FACT FILE



Flash, Version 6.0
Software Masters Inc.
6352 N. Guilford Ave.
Indianapolis, IN 46220
(317) 253-8088
List Price: \$69.95 (\$25
upgrade fee).
Requires: DOS 2.0 or
later

In Short: An enormous variety of options, parameters, and add-ons makes this one of the most effective and powerful caches available. Distribution disks copy protected until registration.

CIRCLE 647 ON READER SERVICE CARD

FAST!



Disk
Performance
Utility
Program



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Our superhuman advantage is achieved by very simple means. We took the well-proven speed-enhancement technique called "disk caching" and improved it, by a mile.

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Which means that your CPU spends almost no time waiting for disk reads,

the most notorious time-glutton of all. The more disk-intensive your application (database, for example), the more time FAST! will save you.

And since FAST! keeps your data in memory, it has the pleasant side-effect of reducing wear and tear on your drive, thereby extending its life.

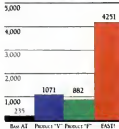
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FAST! is priced at just \$99, making it competitive with other disk-enhancement utility products. But let's face it—they're not even in the same league.

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BUFFERS AND FASTOPEN: CHEAP CACHE FROM DOS

DOS has its own clever ways of speeding your system's performance.

Long before IBM produced *IBMLCACHE*, DOS began to include a primitive cache of its own in the form of the *BUFFERS* command in *CON.FIG.SYS*.

Whenever an application asks for data from a disk, DOS stores the most recently read sectors in a buffer. If the application asks for more data from the same sector, DOS can take the data from the buffer and doesn't have to go back to the disk a second time.

Buffers speed up disk reads in the same way. Whenever DOS writes to a sector, it reads the sector first. If the sector is already in memory, DOS can skip the read stage and concentrate on writing the new data to disk.

All versions of DOS let you specify the number of buffers you want DOS to keep available in memory. Before DOS 3.3, if you didn't specify, DOS assigned two buffers to PCs and XT's, three to AT's. Starting with DOS 3.3, DOS calculates the default number of buffers depending on the capacity of your floppy disks and the RAM in the computer.

You can set *BUFFERS* anywhere from 1 to 99, but higher numbers degrade performance because DOS spends too much time searching through the buffers for the data it needs. If you use a separate disk-caching program, set *BUFFERS* to 3 or 4. If you don't use a separate cache, a figure between 10 and 20 is probably about right.

DOS 3.3 also introduced *FASTOPEN*, a separate cache that DOS uses to locate files. When you run *FASTOPEN* from the DOS command line or *AUTOEXEC.BAT*, it opens a small area in memory in which it stores the physical location of each file that you open. When you need to open the same file again, DOS can find its address from the *FASTOPEN* cache instead of going to the disk's FAT and directories.

A typical *FASTOPEN* command might look like this:

```
c:\dos\fastopen c:=70
d:=30
```

This tells *FASTOPEN* to store the locations of 70 files on drive C and 30 files

from drive D. You can specify as few as 10 files for each drive or as many as 999 files for all drives combined; the default figure is 34 files per drive. Each file location takes up 35 bytes of RAM, and once you've reached the limit, *FASTOPEN* won't accept any more data.

If you use a third-party disk cache, *FASTOPEN* won't speed up performance, and you're better off ignoring it. But if you don't use a disk cache, *FASTOPEN* can dramatically speed up access to files buried deep in your directory structure.

But be careful with *FASTOPEN*. If you use a disk defragmenter utility while *FASTOPEN* is in memory, you may demolish your data. That's because *FASTOPEN* doesn't know that the defragmenter has moved your files, and *FASTOPEN* will look for them in the place where they were stored before you used the defragmenter. If DOS tries to write to the original location, your files, directories, and file allocation table will be corrupted, and it's time to reach for the backups.—Edward Mendelson

some systems fits between DOS's 640K boundary and the 1MB starting point of AT extended memory. You can put together a single cache comprising all five different kinds of memory. You can force specific files or data to stay in the cache during an entire session. You can temporarily stop adding to the cache if you interrupt one program to use another but want to retain the contents of the cache for your return to the first program. You can store buffer contents to a disk file and reload it into the cache at your next session.

You can even make *Flash* display an imitation drive-light when it accesses the cache. You can turn off caching of individual drives. You can protect drives against formatting. You can make the Ctrl-Break key combination flush the cache. You can even tell *Flash* to refrain from adding itself to the cache when you run it to change op-

tions or report on performance.

With caches larger than 512K you can tell *Flash* to streamline its lookup tables by indexing disk information by track rather than sector. This option, which the instal-

■ *Flash* can streamline its lookup tables to let you create a cache of up to 32MB.

lation program selects for you automatically when you specify a large enough cache size, lets you create a cache of up to 32MB. Without the option, you're limited

to an already generous 3MB.

I normally like to see as many options as possible built into a program, but *Flash*'s enormous range of choices has one disadvantage. The program code carries the extra baggage of options that often take more time to use than they can possibly save. If you create a 512K cache in LIM memory, you lose 36K from DOS's 640K of conventional memory, even when you store the lookup tables in LIM memory along with the cache buffers. You can reduce this to 25K at the price of some speed. The same cache in AT extended memory takes up 31K, but *Flash* has a unique feature that lets you reduce this to 25K by loading a separate device driver that puts the lookup tables into extended memory together with the cache buffers.

These figures are relatively small, but other caches, some of them equally fast or

From creation

To completion...

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Vendor # 107 DATE 11-10-88 ORDER # 1017 TAXABLE NONTAXABLE ☒ ☐ PLEASE SEE COMPLETE TERMS OF PURCHASE AGREEMENT ON BACK

Vendor: Best Furnishings 123 Northern Blvd., North Hills, CA 90051 Ship to: Pacific Vanities, Inc. South Beach Branch 101 Camp Road South Beach, CA 90008 Andrew (x3337)

PAYMENT TERMS Due 30 REQUIRED BY A/R FOR SOUTH HILLS, CA PARTIAL SHIPMENT ☒ ALLOWED ☐ NOT ALLOWED

Item	Qty	Description	Price	Amount
1	1	Conference table, model P-17	1500.00	1500.00
2	8	Chairs, model CC-55	250.00	2000.00
3	1	4' by 4' blackboard	80.00	80.00

Total Purchase Amount 3580.00

Special Instructions or Remarks: Bill to address same as ship to address. Note: Please be careful with color match of chairs. Above quoted prices were confirmed on Oct 1st by checking in with shipping/receiving dept. Call Andrew before delivery.

AUTHORIZED BY [Signature] DATE 11/10/88

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Reservoir Place, 1601 Trapelo Road, Waltham, MA 02154

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CIRCLE 174 ON READER SERVICE CARD

DCACHE: THE ULTRAMINIATURE

You can make your next visit to PC MagNet a trip to the cache machine.

In PC MagNet's Utilities Database, you'll find Doug Boling's *PC Magazine* utility, DCACHE (October 11, 1988), available for quick downloading. DCACHE is certainly the tiniest cache program ever written. Load its buffer into LIM expanded memory, and you'll give up a tiny 1.1K of DOS memory. You can also load DCACHE into DOS memory if you want to give up the space, but not into AT extended memory.

DCACHE speeds up disk reads and writes, often dramatically, and its algorithms strike a clever compromise between those that access a lot of data in the

cache and those that access data quickly. But there's a limit to what you can do in 1,100 bytes of RAM. Larger programs use their extra code to store more data for longer periods and will speed many disk accesses even more dramatically than DCACHE can.

But if your application program needs all the RAM it can find, and other caches take away too much precious space in DOS's narrow envelope, DCACHE can be indispensable. Nothing else gives you extra speed at the cost of so little memory. Even a little cache is a lot better than none.—Edward Mendelson

faster, have fewer arcane options and fit into even less DOS memory. You won't think about this question if you have a 386 machine, because you can use a memory manager like *QEMM-386* or *386-to-the-Max* to load *Flash*'s code into high memory and not take up any space in DOS.

DEFEATING COPY PROTECTION

Flash's distribution disk is copy protected, but the disk modifies itself after you enter your name in a registration screen, and you can then freely copy all the files to as many disks as you like. The installation program asks you a long series of questions that won't be puzzling if you have some basic knowledge of DOS. At the end it gives you a choice between letting the installation program modify your *AUTOEXEC.BAT* file or writing down the parameters to use when you load the cache. A separate help program gives you copious but misspelled and sometimes obscure text screens with information about parameters and options.

The installation program also lets you install a RAMdisk that shares memory with the cache and a keyboard speedup program. An additional \$25 will get you *Spool Master*, a print spooler that shares RAM with the cache; \$69.95 will buy you *Flash-EMS*, which creates expanded

memory using the LIM 3.2 specification in memory shared with the cache, or in other extended memory, or on a disk. There must be something you can do with a cache that you can't do with *Flash*, but if so, I haven't found it.

IBMCACHE

Worried that your cache software might violate IBM's rules? One cache that's guaranteed to work on IBM computers is the cache written by IBM and supplied with all

Micro Channel PS/2 machines. Like most IBM products, *IBMCACHE* is a conservative and solid design. Because it's 100 percent IBM compatible, it may help you sleep more soundly. Unfortunately, if you're using *IBMCACHE* with one of the notoriously slow hard disks on IBM's 80286 machines, you won't get to sleep any earlier.

In the PC Labs benchmark tests, *IBMCACHE* turned out to be the slowest cache of all. In one limited category of the tests—file reading of small records—it performed almost as well as the best programs. But in reads of large records and in all file writes, it produced results that generally were no better and were sometimes a bit worse than no cache at all.

Sharp-eyed readers will notice that PC Labs performed its benchmark tests on an IBM PC AT, not on one of the PS/2 computers for which *IBMCACHE* was apparently designed. To determine whether *IBMCACHE* roars to life on a PS/2 machine, we ran it on a PS/2 Model 80 and compared the results with those of *Super PC-Kwik* running on the same machine. Even on the Model 80, *Super PC-Kwik* outperformed *IBMCACHE* by a factor of 6:1 in the small records test and 2:1 with the large records. Suffice it to say that you wouldn't want to buy a Model 80 merely to get a copy of *IBMCACHE*.

FINDING THE CACHE *IBMCACHE* comes on the reference and setup diskette supplied with IBM's PS/2 computers numbered from Model 50 on up, and also with the Model 30/286. As documentation, IBM generously supplies the front and back of a single page, which turns out to be all you really need. Don't try to find the program by asking DOS for a directory of the setup disk. Both the installation file and the cache file itself are hidden files, presumably to discourage you from trying to install them by simply copying them to your hard disk.

IBM sensibly wants you to use the installation program, which is in many ways much better than the cache software itself. Insert the reference disk, change the current drive to drive A:, type *IBMCACHE*, and you'll be presented with a clear and elegant series of menus, complete with help screens available at the touch of the F1



FACT FILE

IBMCACHE

IBM Corp.

Contact your local IBM dealer.

List Price: Included with PS/2 Models 30/286, 50, 50Z, 60, 70, and 80.

Requires: DOS 3.3 or later.

In Short: Highly conservative and the slowest of all caches tested, this program works with conventional, expanded, and extended memory. It won't cache floppy disks or non-standard disks like a Bernoulli box. Not copy protected.

CIRCLE 646 ON READER SERVICE CARD

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■ DISK-CACHING SOFTWARE

key. The menus let you decide whether to install the cache in DOS memory or in AT extended memory; then they set the size of the cache buffers and decide how many sectors to use in the "page" that that cache reads each time it reads the disk.

You won't go wrong by selecting the defaults. If you choose low memory, the cache will occupy 64K; if you opt for extended, 128K. Function keys let you choose among a series of preset buffer sizes ranging from 16K to 512K for DOS memory and up to 4,096K in extended memory—but if you type in a figure that doesn't match the preset choices, the cache will gladly use the figure you prefer. If you have enough extended memory, you can take up to 15MB for the cache. Your choice of page size is limited to 2, 4, or 8 sectors, with 4 as the default. The default page size corresponds to the cluster size on a standard PS/2 hard disk, although 8 sectors should yield slightly better performance with large files.

When you're through with installation, the installation program and the cache itself are copied to the root directory of your hard disk and the appropriate command is added to your CONFIG.SYS file. The copies on the hard disk have the hidden attribute removed so you can see them and reinstall the cache without hauling out the reference diskette.

IBMCACHE won't cache floppy disks and won't cache any nonstandard disk, such as a Bernoulli box. It does cache hard disks, but you may have to look very closely at the benchmarks to notice.

Lightning

Lightning strikes—it doesn't do polite things that leave your disk unchanged. Personal Computer Support Group's \$89.95 *Lightning* disk cache lives up to its name when it strikes your disk by writing to it. *Lightning*'s scores in the disk write tests were among the two or three fastest, and even in the more polite area of file reading it ranks among the speedier caches. Only its relatively slow performance in the file creation part of the benchmark tests kept it out of the very highest ranks in terms of overall performance.

Lightning doesn't have all the options of other caches, but it has most of the es-

sential ones. You can switch on caching for individual disks, whether floppy or fixed. You can disable, reenable, or uninstall the cache from the DOS command line and receive a report on statistics. You can even switch on a software equivalent of a write-protect tab for individual drives so that nothing can be written to the drive at all until you give your approval.

An option not mentioned in the manual lets you limit caching to read requests that involve a specified number of sectors or fewer than that number. This option can prevent a small-sized cache from being cleared out and replaced every time you read a large file or run a large program. The forthcoming release of *Lightning*, Version 5.0, will include an option to lock the contents of the cache. This will let you run CHKDSK to put the FAT in memory, and then lock the cache to save time in all disk reads.

If you want a cache that speeds your disk without making you waste time in fine-tuning its options, these are all the choices you need. For most purposes, *Lightning* does the job and does it at top speed. It won't procrastinate by writing redundant data to disk, and it detects floppy disk changes. It can cache most disks that require a device driver in your CONFIG.SYS file, but it's limited to one such driver. The program has evolved over 3 years and by now has an enviable record of safety and reliability. It still gets mildly confused by drive letters identified by

SUBST, and it can think that you have more disks than there actually are in your machine, but this is only a cosmetic flaw and doesn't affect its operation.

A FUTURE EXTENSION The current version of *Lightning* exploits DOS memory or a combination of DOS and LIM expanded memory, but it won't touch AT extended memory. *Lightning*'s Version 5.0 will make using extended memory an option. Until then, if you load *Lightning* without specifying any parameters, it occupies 60K of RAM by default and puts 48K of that into LIM memory if it finds it. That 60K figure is the sum reported by the manual and by the program when it loads. PC Labs measured the RAM occupied by the default configuration as 70K. With LIM memory available, 23K of that total was in DOS, the rest in LIM.

You can use up to 1.8MB of LIM expanded memory for the cache; Version 5.0 of *Lightning* will occupy up to 8MB. If you attempt to use more, *Lightning* will refuse to load. You can't tell *Lightning* to stay away from LIM memory if it finds it, although it's possible to imagine situations where you might prefer to keep your LIM memory free for spreadsheets and reserve a cache in DOS memory instead.

To install *Lightning*, simply enter the letter L at the DOS prompt. To use a larger cache size than the default, enter L followed by the number of kilobytes. The program doesn't come with any installation routine, and you don't need any. The clear but somewhat sketchy manual explains how to modify an AUTOEXEC.BAT file to include the cache. Except for a two-page addendum in the back, the manual seems unchanged from the 1985 version of the program and still refers to a copy-protected version that is fortunately no longer available. The manual also refers to the statistics screen as a "fun feature." I hope the folks at PCSG have found better ways to have fun in the years since they wrote that.

Lightning strikes faster than much of the competition in disk writes, but it lacks the advanced options of some other caches, and its list price is one of the highest of the group. If you buy one of PCSG's well-designed and inexpensive Breakthru accelerator boards for PCs and XT's, *Lightning* comes in the package, and the combi-



FACT FILE



Lightning, Version 4.82
Personal Computer
Support Group Inc
4540 Bellway Dr
Dallas, TX 75244
(800) 544-4699
(214) 404-4000
List Price: \$89.95

Requires: 128K RAM; IBM PC/XT/AT,
PS/2, or compatible, DOS 2.0 or
later.

In Short: Very fast disk writes combined
with limited installation options make this a
good but not spectacular cache. Not copy
protected.

Circle 645 on Reader Service Card

■ DISK-CACHING SOFTWARE

nation is a bargain. Even when purchased on its own, *Lightning's* speed and reliability may make it more of a bargain in the long run than some of its elaborate rivals.

Mace Utilities


Sturdy, reliable, competent—these are the adjectives that seem to have attached themselves to the disk-testing and file-recovery programs included in the *Mace Utilities* over the past few years. The new Version 5.0 of the \$99 basic utility package and the \$149 advanced Mace Gold version won't shake these adjectives loose.

The latest *Mace* package contains an entirely new set of cache programs: one for AT extended memory, one for LIM expanded memory, and one for conventional memory. Each occupies a very small amount of memory and requires no attention after you've installed it. Each expe-



FACT FILE

Mace Utilities, Version 5.0
 Paul Mace Software Inc.
 400 Williamson Way
 Ashland, OR 97520
 (800) 523-0258
 (503) 488-2322
 List Price: \$99 (\$149 for Mace Gold)



Requires: 256K RAM; IBM PC/XT/AT, PS/2, or compatible; DOS 2.0 or later.
In Short: The ultrafast disk reads of the *Mace Utilities* cache are offset by slow writes for overall lackluster performance. But in the same package you get *Mace's* disk-testing, file-recovery, defragmenting, and directory-sorting utilities, and a replacement for DOS's FORMAT command—far better reasons to buy the package than for its cache alone. Not copy protected.

CIRCLE 644 ON READER SERVICE CARD

ditates disk reads impressively but doesn't help with disk writes. In overall performance, the three *Mace* programs came in second to last, just ahead of the ultraconservative *IBMCACHE*. But in disk reads, especially in the large record tests, *Mace* often produced faster speeds than any other cache, including the most ambitious.

HANDING DATA TO DOS *Mace's* excellent large-record performance is related to its insistence on reading (and writing) a full track every time it touches the disk. Because it needs to monitor only the tracks it keeps in its buffer, *Mace* can maintain a small lookup table and can quickly hand data over to DOS. *Mace* makes you give up a mere 10K of conventional memory when you keep a 512K cache buffer in AT extended memory, and 9K when you keep the cache buffer in LIM expanded memory. Curiously enough, when PC Labs specified a 64K cache in conventional

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memory, *Mace* occupied only 61K—a bit less than the official minimum of 64K. The maximum cache size is 16MB of AT extended memory, 8MB of LIM expanded memory, or 384K of DOS memory.

Installing the program won't take much time. Simply add one line to your CONFIG.SYS file listing the version appropriate to the memory in your computer: MCACH-AT.SYS, MCACH-EM.SYS, or MCACHE.SYS. If you don't specify a size for the cache, the buffer defaults to 384K of extended, 256K of expanded, or 64K of conventional memory. You can specify caching of the first or second of the physical hard disks in the system (each of which may of course be divided into multiple partitions). *Mace* won't cache floppy disks or installable DOS devices like the Bernoulli Box.

If you want, a separate CACHCTRL program reports whether the cache is installed and turns caching on or off. Be-

cause the cache is a device driver, there's no way to free its memory without rebooting, but it's so small that you probably won't care. CACHCTRL can also run a timing test that compares the timing of disk reads and writes with the cache turned on and off. With admirable honesty, this benchmark reveals that disk writes are slightly slower when the cache feature is switched on.

There are plenty of good reasons to buy the *Mace Utilities*. The package includes well-written disk-testing, file-recovery, defragmenting, and directory-sorting utilities, as well as an excellent replacement for DOS's FORMAT command that can help recover data from an unreadable floppy disk. *Mace's* cache isn't enough to make you rush out and buy the package, but if you buy it for the other programs included, and if you don't have another cache already, you'll find it a worthwhile bonus.

PC Tools Deluxe

Central Point Software's \$79 cornucopia contains tools that can do just about anything to your disk except paint it purple. *PC Tools Deluxe* comes with backup and restore programs, a defragmenter, format and directory utilities, and even a text editor. Of course you get a cache feature in the package as well, and the PC-CACHE program included in the new version—5.0—of the package proved to be as smart and effective as many standalone products. This isn't surprising, since the cache in *PC Tools Deluxe* is a reduced version of *Super PC-Kwik*. Central Point knows a good thing when it sees one.

Compared with the full version of *Super PC-Kwik*, PC-CACHE isn't as fast in file creation, although it's closely comparable in disk reads and most disk writes. In the PC Labs benchmark tests it even surpassed the full version in many tests, al-

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*optional



CIRCLE 740 ON READER SERVICE CARD





FACT FILE



PC Tools Deluxe,
Version 4.30
Central Point
Software Inc.
15220 NW Greenbrier
Pkwy., #200
Beaverton, OR 97006
List Price: \$79

Requires: 256K RAM; IBM PC/XT/AT,
PS/2, or compatible; DOS 2.0 or later.

In Short: A reduced version of *Super PC-Kwik*, this cache is a member of a group of utilities but is as smart and efficient as many standalone products. Not as fast as *Super PC-Kwik* in file creation, but produces closely comparable speeds in disk reads and most disk writes. Not copy protected.

CIRCLE 643 ON READER SERVICE CARD

though this was the result of the choice of parameters we made when testing the full version rather than a sign that the reduced version is actually a more powerful product. PC-CACHE is so similar to *Super PC-Kwik* that if you try to install it while the parent version is already present in your system, it will refuse to load and will report that it is already installed.

Like its slightly larger original, PC-CACHE doesn't take up much space in RAM. When you create a 512K cache in LIM expanded memory, the cache fills 16K of DOS memory; the same cache in AT extended memory wrests 20K from DOS. It's true that PC-CACHE doesn't have the rich variety of options that are offered by the full version, but you can exclude specific drives from the cache, specify the size of the read ahead buffer, and set a parameter that helps prevent problems with communications software when the cache runs in AT extended memory. You can flush the cache, remove it from memory, or get a report on its performance and parameters.

AUTOMATED INSTALLATION *PC Tools Deluxe* includes an automated installation process; alternatively, you can add PC-CACHE to the command line. If you don't specify the size and location of the cache, it first tries to install itself in expanded, then in extended, memory. If it

finds 128K or more of either type of memory, it occupies one-half of the available space or 256K, whichever is smaller, but you can specify up to 16MB if you choose. If you have only conventional memory, it defaults to 64K, but you can use up to 512K.

If you bought Version 4.0 of *PC Tools Deluxe*, you may already have this new version of PC-CACHE. Look for a README file on the disk that reports that the program has been completely rewritten and allows some additional parameters. If that README exists on your copy of Version 4.0, you have the new *Super PC-Kwik*-based version of the cache. If not, you have a different cache program that uses the same filename.

PC-CACHE won't give you the advanced disk-writing functions that help make *Super PC-Kwik* so impressive, but it does more than enough to keep most users satisfied. And it's only part of a package that includes some of the best-written disk utilities available anywhere.

PolyBoost II

The nine (yes, nine!) cache programs in Polytron's \$79.95 *PolyBoost II* package of disk utilities all share one distinguishing characteristic: speed. In both AT extended memory and LIM expanded memory, the Polytron caches almost consistently took first place in the read and write tests of the PC Labs benchmark series. Their relative-

ly poor showing in the file creation tests and their good but not dazzling performance in conventional memory dragged the package back to the third place in the overall tests, but if what you want most from a cache is speed, one of these nine caches may be the one to choose.

You get eight different caches for eight different combinations of processors and disk types, and you can mix and match to suit your configuration. (The ninth cache is an alternative extended-memory cache in case you have trouble with one of the others.) There are four separate caches for standard hard disks and four for floppy disks. Each set of four has one program that puts a cache in conventional memory, one that uses LIM expanded memory, one for extended memory in an 80286 machine, and one for extended memory in an 80386.

LOADING TWO COPIES Each program can cache one physical drive, but you can load two copies of the same program to cache two drives. Let's say you have an 80286 computer with extended memory, an add-in board that includes LIM memory, and two physical hard disks, the first of them partitioned into two logical drives. Your AUTOEXEC.BAT might include lines like these:

```
polyboost b: 32
extboost c: 100 readahead=3
emboost e: 512
```

This would create a 32K cache in conventional memory for drive B:, a 100K cache in extended memory for drive C: (and in the process, also for drive D:, because D: is the second partition on the first physical drive), and a 512K cache in LIM expanded memory for the second physical drive. The "readahead=3" parameter causes the cache to read a total of four sectors every time it receives a request to read a single sector. You can specify read-aheads of only one, two, or three additional sectors on each read.

Even multiple caches like these won't take up a lot of memory. A 512K hard disk cache buffer in AT extended memory eats away only 12K of RAM from DOS's 640K. The same-sized buffer in LIM expanded memory takes 11K. Although these figures are among the smallest of any



FACT FILE



PolyBoost II,
Version 2.03
Polytron Corp.
1700 NW 167 PL
Beaverton, OR 97006
(503) 645-1150
List Price: \$79.95
Requires: 256K RAM;
IBM PC/XT/AT, PS/2, or compatible; DOS
2.1 or later.

In Short: Nine very fast caches, each designed for different disks and configurations. The package also includes a hard disk defragmenter and programs that test memory and unload TSRs. Not copy protected.

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■ DISK-CACHING

cache, keep in mind that each physical disk requires a separate cache program and a separate expenditure of DOS memory.

Polytron recommends against caching floppy disks when caching hard disks. This recommendation makes sense when using Polytron's approach to disk caching, which uses a separate cache for each drive. But it makes less sense when applied to any of the more elaborate cache programs that can use the same memory pool for caching different disks.

HELPFUL PROMPTS If you install the disk caches manually and the program encounters an error, it prompts you for the correct parameter rather than dumping you back into DOS to try again. You can also use an automated installation program that modifies your AUTOEXEC.BAT and gives you the opportunity to use separate programs to speed the keyboard and screen display. The keyboard speeder also lets you edit any text you enter on the DOS command line. The package includes an ultrafast but somewhat dangerous hard-disk defragmenter and programs to test memory and unload TSRs. You also get control programs and status displays that operate either as a TSR or from the DOS command line. If you have a cache loaded, you can get a quick report on the percentage of reads and writes because the cache was present, but you can't alter any parameters. The cache is probably working too quickly for you to want to, anyway.

Quickcache II

If you want absolute control over every imaginable detail of your disk-caching software, you can choose one of two procedures. You can learn assembly language programming and write your own. Or you can use *Quickcache II*.

If you let this \$59 program from P.R. Glassel and Associates install itself and set its own parameters, the second of these two choices can be virtually effortless. But if you decide to use *Quickcache II*'s many options and parameters in order to fine-tune its operation, the second choice may seem almost as complicated as the first.

In the PC Labs benchmark tests, *Quickcache II* performed adequately but was not among the better performers. A 512K

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■ DISK-CACHING

cache installed in either LIM expanded memory or AT extended memory took away 42K of DOS memory, a figure exceeded only by *Fast Forward*. But if other caches are faster or smaller, none allow greater freedom of customization and fine tuning.

NOT FOR NOVICES Before adjusting *Quickcache II* to perform at its best, you need some solid grounding in the technicalities of DOS and disks. The manual reflects an obviously sincere effort by the author to make the program accessible to the average user. But the average user that the manual has in mind is one who understands that "flushing dirty sectors" means writing data to disk that DOS or an application program has sent to the disk but the cache has been holding in memory.

By working through the index and cross-references, a nontechnical user can eventually figure out the meaning of "cylinder flush," "lock pool size," and "threshold weight." But that same user may feel left out when he reads a paragraph suggesting that if his keyboard hardware is not fully IBM compatible, he can write a memory-resident program that will tell the cache to flush sectors at the press of a hotkey.

Technically adept users, especially those with mainframe experience, will feel right at home. With *Quickcache II* installed and running, advanced users can modify almost all parameters on the fly. If

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PC FACT FILE



**Quickcache II,
Version 4.83**
P.R. Glasel and
Associates Inc.
30255 Fir Trail
Stacy, MN 55679
(612) 462-1337
List Price: \$59

Requires: 20K RAM, DOS 2.0 or later.
In Short: Total control over options and a technically advanced manual make this a cache best suited for advanced users. An adequate performer, but not one of the faster programs tested. Not copy protected.

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■ DISK-CACHING SOFTWARE

you want to see how performance is affected by setting a 9-sector read buffer and an 18-sector write buffer on drive A: while setting 17-sector buffers on drive C:, you can do so at any time. If you want to

"lock" some files into the cache buffers when you run a program and clear them out later, you can do that either from a menu, from the DOS command line, or from a batch file. You can even alter the in-

ternal workings of the cache by fine-tuning the extra priority it will give to retaining sectors that contain FAT and directory entries. You can modify the cache by using any of 40 different commands ranging from "autodismount" to "writebuffer-size."

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CIRCLE 221 ON READER SERVICE CARD

MAXIMUM SAFETY Quickcache II's installation is designed for maximum safety. If you examine the directory of the distribution disk, you won't find a cache program at all—only a README file, an INSTALL program, and about 15 files with names like Q011. These turn out to be compressed files that the INSTALL program expands to their proper size during installation and combines into the cache program itself. Don't bother copying these compressed files to your hard disk because the INSTALL program insists on reading the files it needs from a floppy disk—either the distribution disk or a copy of it.

The installation routine creates an executable cache program customized to your computer. If you have an 8088 machine, you will end up with a different cache than you will if you have an 80386. For safety reasons, this customized file incorporates a bit of your computer's BIOS, and it won't run if you copy it to another machine. The distribution disk is not copy protected, so you can install the cache on more than one machine, but each installation may produce a slightly different program.

With your permission, the installation routine will add three lines to your AUTOEXEC.BAT file: one line to set the path where the cache looks for its help files, another to start the cache program, and a third that tells the cache program to start caching your disks. You can add other lines that contain special commands to adjust the operation of the cache.

As these multiple lines indicate, the cache program itself is different from the programs that control it. A "menu-processor" program displays a menu that lets you change parameters interactively; a separate program lets you alter a slightly different set of parameters from the DOS command line; and a third program configures the cache for future operations.

Of course, you can ignore all these control programs and let Quickcache II do its job in its quiet and effective way. If you

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CIRCLE 173 ON READER SERVICE CARD

■ DISK-CACHING SOFTWARE

don't like the quiet, you can command it to generate a small symphony of buzzes and beeps whenever it adds data to the cache or reads data already there.

SMARTDrive

If you have a copy of a current version of *Microsoft Windows*, then you have a copy of *SMARTDrive*. Microsoft includes this cache program as a way of giving *Windows* a much-needed burst of speed. If you bought a copy of *Windows* and decided not to use it, you may still be able to find some use for *SMARTDrive*. There are better caches out there, but at least you won't have to go out and look for one.

SMARTDrive has two distinctions: it is designed to work with *Windows*, and it reads files with impressive speed.

DYNAMIC MEMORY EXCHANGE

SMARTDrive is the one cache that can dynamically exchange LIM memory with *Windows*. When *Windows* needs elbowroom during a computer session, it borrows memory from the cache; when *Windows*'s requirements diminish, it gives memory back. *Windows* can do this only when *SMARTDrive* is loaded into LIM expanded memory. Although you can load the cache into AT extended memory, *Win-*

dows won't be able to borrow that memory when it needs it. *SMARTDrive* can't be loaded into DOS memory at all, presumably because *Windows* itself needs all the DOS memory it can get.

In the PC Labs benchmark tests, *SMARTDrive* generally tied for first place in the file-reading tests when using large records. It tended to lag slightly behind in small records. In file writing and file creation, its performance was worse than the results obtained by using no cache at all.

You install *SMARTDrive* by adding a line like this to your *CONFIG.SYS* file:

```
device=c:\windows\smartdrv.  
sys512 /a
```

If you don't specify the amount of memory you want *SMARTDrive* to use, it will create a cache of 256K, although you can specify any figure from 124K to 4096K. The /a parameter specifies LIM expanded memory; without it the cache buffers go into AT extended memory instead. The cache displays a report on its size when you boot and then becomes invisible for the rest of your computer session. Like all device drivers, the cache can't be removed from memory unless you rewrite your *CONFIG.SYS* file and reboot the computer.

SMARTDrive will cache any standard hard disks in your system, but it ignores floppy disks and any disk installed with a device driver, such as a Bernoulli Box.

READING ISN'T BELIEVING Don't believe everything you read about *SMARTDrive* in the *Windows* manual. Microsoft tells you, "When running *Windows*, you should use *SMARTDrive* as replacement for any memory-disk program (such as *VDISK*) or any disk-caching program (such as *Vcache* or *Lightning*)" because other cache programs aren't "designed to work with *Windows* to make the best use of the memory in your computer." If you intend to use nothing but *Windows* applications and you plan to load *SMARTDrive* into LIM expanded memory, and it you don't have much memory to spare, this statement may have some plausibility. Other caches can't dynamically reduce the size of the buffer when *Windows* needs space, and *Windows* doesn't make much use of a RAM disk.

But the recommendation in the manual is of questionable value if you use non-*Windows* programs or intend to keep *SMARTDrive* loaded into AT extended memory. When *SMARTDrive* takes up space in extended memory, it holds on to that memory until you reboot; it can't share it with *Windows*. You'll get better results from any of the faster cache programs.

And if you have a lot of LIM memory available, you'll get the best results of all by reserving 512K for a fast cache program and letting *Windows* use the rest. In our tests, *Windows* applications loaded more quickly with a 1MB *Super PC-Kwik* cache than with an equivalent *SMARTDrive* cache.

One common misconception about *SMARTDrive* is that it works only with *Windows* and nothing else. *SMARTDrive* stays active when you exit *Windows* and continues to cache data that you read from your disk or write to it. If all you do is read files, *SMARTDrive* is more than adequate. If you decide to get some real work done and write something to disk, you'll want a faster cache.

Super PC-Kwik

In a world where disk-caching programs tend to have knockout names like *Warp-Speed*, the name *Super PC-Kwik* sounds like a tongue-twisting mouthful. Don't be misled, though. In overall performance, Multisoft's \$79.95 *Super PC-Kwik* roared



FACT FILE

SMARTDrive

Microsoft Corp.
16011 NE 36th Way
Redmond, WA 98073-9717
(206) 882-8080

List Price: Included with *Microsoft Windows/286* or *386*, *Windows/286*, \$99, *Windows/386*, \$195.

Requires: 286 version: 512K RAM, one 1.2MB floppy disk drive; hard disk; EGA or VGA monitor; DOS 3.0 or later. 386 version: 386 machine or IBM PS/2 Model 80; 2MB RAM; hard disk; 1.2MB or 720K floppy drive; EGA or VGA monitor; DOS 3.1 or later.

In Short: The only cache that exchanges memory with *Windows*, *SMARTDrive* reads files with impressive speed. Otherwise it is undistinguished. Not copy protected.

CIRCLE 640 ON READER SERVICE CARD



EDITOR'S CHOICE

FACT FILE



Super PC-Kwik,
Version 3.08
Multisoft Corp.
15100 SW Koll
Pkwy., Suite L
Beaverton, OR 97006
(503) 644-5644
List Price: \$79.95

Requires: 64K RAM; IBM PC/XT/AT, PS/2, or compatible; DOS 2.0 or later.

In Short: A useful set of options, small memory usage, and the fastest overall speed of any cache tested. One of the easiest to use and most adaptable caches you'll find. Not copy protected.

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CIRCLE 727 ON READER SERVICE CARD



EDITOR'S
CHOICE

• Super PC-Kwik

Speed is the only reason to use a disk cache, but speed isn't the only criterion to use in choosing one. The best cache program is the one that speeds up disk activity while occupying the least DOS memory and adapting to the special requirements of your work and your computer.

Super PC-Kwik is the fastest cache program available, and it's also the one with the most useful and sensible options. You can squeeze it down to as little as 9K of RAM and still maintain a half-megabyte cache in expanded memory. You can also benefit from its speed and intelligence if you keep the cache in conventional or extended memory.

When you combine it with the RAMdisk, print spooler, and other programs in Multisoft's PC-Kwik Power Pak, Super PC-Kwik makes better use of your memory than any other cache you can buy.

If you don't want to buy a separate cache program, you can get a reduced version of Super PC-Kwik as part of the current version of the PC Tools Deluxe disk utility package. But nothing approaches the fleet intelligence of the full version.

into first place in the PC Labs benchmark tests.

Speed is only one of this program's many attractions. Super PC-Kwik is one of the most adaptable and easy to use of all caches, with advanced options that let you shave the last possible microsecond from disk reads and writes. And you can combine the cache with optional companion programs that let you share a single memory pool among the cache, a print spooler, a RAMdisk, and even a utility that can play back data written to the screen.

Although Super PC-Kwik came in first

in the overall speed trials, it wasn't first in most of the individual tests. In fact, in the read and write tests, it generally came in second or third. But in the file creation test it demolished the competition, often producing results three or four times better than those that its closest rival produced. Its preeminence in this test, combined with its overall excellence in the other tests, put it far ahead of the pack.

TAILOR-MADE FOR LIM Super PC-Kwik and LIM expanded memory seem to be made for each other. Although the program does an excellent job in conventional and AT extended memory, its impressive speed records are set in LIM expanded memory. Super PC-Kwik also knows how to store much of its own code, in addition to its cache buffers, in LIM memory instead of filling up valuable space in DOS's 640K. If you create a 512K buffer in LIM memory, Super PC-Kwik normally occupies a mere 16K of DOS memory. If you're willing to trade away the slight benefit of full rather than partial track reads, you can reduce the program's share of DOS RAM to a mere 7K. To get an equivalent 512K buffer in AT extended memory, you have to give up 43K from DOS—although an optional parameter lets you reduce this to 16K in exchange for slightly reduced performance.

This small amount of code contains an impressive range of features, all of which can be switched on or off to suit your needs. Super PC-Kwik uses algorithms that optimize disk writes to reduce head movement and to reduce the number of rotations required to write to disk. Multisoft decided for safety reasons to omit any time-delayed disk-writing options, but you can assign disk reads priority over disk writes.

The program normally doesn't waste time writing to disk if it finds that the data waiting in the cache matches the data on disk, but you can turn off this option for better performance in AT extended memory. You can also make disk writes continue in the background while your application goes on with its work. When you copy files to a floppy, you'll be pleasantly surprised to find that you're back at the DOS prompt long before the copies are complete and the drive light goes off.

MODERN CONVENIENCES All the best modern luxuries come with the program. You can flush the cache, temporarily disable it, check on its performance and parameters, and remove it from memory. You can tell it not to cache individual drives, or can set different defaults for floppies and hard disks. Super PC-Kwik works with partitions larger than 32K and with the Bemoulli Box, and has no trouble with RLL or ESDI drives. With 386 memory managers like 386-to-the Max or QEMM-386, you can load it in high memory and use up no DOS memory at all.

Installation of Super PC-Kwik is as straightforward as possible. A batch file copies all the files to your hard disk and optionally adds a line to your AUTOEXEC .BAT. Although there are 18 optional

■ Installing Super PC-Kwik is straightforward: it can determine almost all of its own settings.

command-line switches, you can ignore all of them because the program can determine its own best settings. If you have LIM expanded memory in your machine, Super PC-Kwik uses all that's available, up to a limit of 16MB. No expanded memory on board? Then the program looks for AT extended memory, and uses everything it finds, up to 16MB. No extended memory either? The program settles for conventional DOS memory, sets aside 480K for your applications, then uses the remaining RAM for itself.

At the same time, it configures itself to match your hardware. If you have an AT or 386 machine, you automatically get advanced support of disk writes. If any of your drives are nonstandard or work with device drivers, Super PC-Kwik tests them to see which of its advanced options are usable with each disk. When the program loads, it incorporates one of six different subsidiary files from the disk; since each of these files contains features appropriate to different hardware configurations, the pro-

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CIRCLE 176 ON READER SERVICE CARD



■ DISK-CACHING SOFTWARE

gram doesn't have to waste RAM with code that supports other configurations. The manual, which is written in lucid English, gives detailed guidance on which options to choose on your own.

At \$79.95, *Super PC-Kwik* is one of the more expensive caches, but it's one of the very best. If you have a computer made by Dell, Hewlett-Packard, or some other vendors, a reduced version of the program comes with your machine. The cache also forms the core of Multisoft's \$129.95 *PC-Kwik Power Pak*. This includes the full disk cache itself, plus a print spooler, a RAMdisk, a screen-recall program, and additional programs to speed up the keyboard and the screen display. The spooler, the RAMdisk, and the screen-recall program ingeniously share the same memory pool carved out by the cache. The RAMdisk takes memory from the cache only when it needs space to store files; the print spooler occupies memory only while storing data destined for the printer. When you aren't using the spooler or the RAMdisk, the cache reclaims the memory for itself. This set of programs lets you use your expanded or extended memory without wasting a single byte. And *Super PC-Kwik*, either alone or in combination with these programs, lets you use your disk without wasting a microsecond.

Vcache

Vcache is compact, capable, and fast—offering a small but sensible set of options and low memory overhead. You can feel confident about this \$59.95 program from Golden Bow Systems when you install it, and then, as with all good cache software, you can forget that it exists.

In the PC Labs benchmark tests, *Vcache* cut an especially fine figure in the read and write tests, especially when tested with large records. Only its lackluster showing in the file-creation test kept it from catching up with *Super PC-Kwik* in terms of overall performance. It functioned very well in conventional memory and, like most caches, was faster in LIM expanded memory than in AT extended. With a 512K cache in LIM memory, it occupied only 19K of DOS; the same cache in AT extended memory took up 20K.

The distribution disk gives you a choice

of three programs for hard disk caches and a fourth for floppies. For hard disks you can load *CACHE* in conventional memory, *CACHE-AT* in AT extended memory, and *CACHE-EM* in LIM expanded memory. Each uses the same set of options, with an additional option for the extended memory version that lets you specify the cache's starting address. You can run only one of these hard disk caches at a time, but you can run the *VKETTE* floppy disk cache along with any other. *VKETTE* runs just in conventional memory, where it occupies about 26K of RAM.

SPEED BY DEFAULT You'll probably get the fastest results by using *Vcache*'s defaults and simply adding the appropriate program to your *AUTOEXEC.BAT*. By default, *Vcache* will determine on the fly whether you are performing random or sequential reads; if it detects sequential reads, the program will scoop up additional sectors into a read-ahead buffer during each read. The default setting is 4K for ATs and 2K for XT's, but you can specify up to 32K. You can determine the optimum size for this setting by calculating the size of a single track on your disk, so that the cache takes full advantage of any single rotation. The manual isn't explicit about

■ If *Vcache* can't find free time to write to disk, it sounds a "snooze alarm" every 5 seconds until the writes are finished.

this, but it offers a buffer size of 8K as a possible example; 8K will be right for most AT disks.

Vcache uses the same buffer for storing its delayed writes and lets you specify a delay value of 1 or 2 seconds—or no delayed writes at all. If the program can't find free time to write to disk, it sounds a "snooze alarm" every 5 seconds until the writes are



FACT FILE



Vcache, Version 4.0
Golden Bow Systems
2870 5th Ave., #201
San Diego, CA 92103
(800) 284-3269
(619) 298-9349
List Price: \$59.95

Requires: 256K RAM.

IBM PC/XT/AT, PS/2, or compatible; DOS 2.0 or later.

In Short: The second-fastest cache tested. *Vcache* performed very well in read and write tests, especially with large records. Offers a small but sensible set of options and low memory overhead, and is easy to use. Not copy protected.

CIRCLE 68 ON READER SERVICE CARD

finished. You can turn off the snooze alarm if you prefer to get some sleep while the cache waits its turn to write. It also tries to intercept Ctrl-Alt-Del and finish all deferred writes before rebooting.

CACHING 12 DISKS If your disk uses a device driver rather than standard BIOS calls, *Vcache* will cache it anyway. It lets you cache up to 12 such disks as long as no more than four device drivers are involved. Unfortunately, the current version won't let you cache a Bernoulli Box and a hard disk at the same time; it caches the hard disk only. *Vcache* will successfully cache a Bernoulli box if there's no hard disk in the system. A command-line option lets you cache nonstandard disk partitions larger than 32MB, but no special options are required to cache disks partitioned with Golden Bow's *Vfeature* software.

The *VKETTE* floppy disk cache queues writes so fast that you return to the DOS prompt before the drive light goes off. Separate programs also included on the disk speed screen writing and the keyboard typematic rate.

Vcache's manual is short and sweet. You don't have to waste time tuning this cache to meet your needs, but you can gain a lot of time using it. ☐

Edward Mendelson is a contributing editor of PC Magazine.

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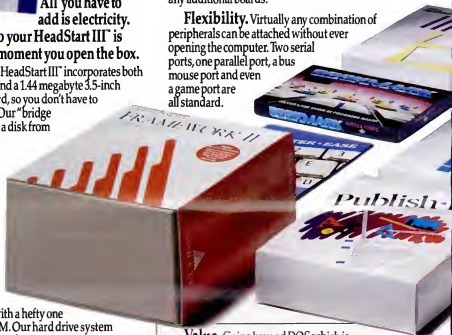
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0000-0001-1941-9470

HARD DRIVE: 32.1 megabyte, 38 milliseconds

1-800-451-7269

E40LT DIN INTERFACES: Parallel, 2- RS232 serial.

1998, 1999, 2000, 2001, 2002, 2003, 2004, 2005, 2006, 2007, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028, 2029, 2030, 2031, 2032, 2033, 2034, 2035, 2036, 2037, 2038, 2039, 2040, 2041, 2042, 2043, 2044, 2045, 2046, 2047, 2048, 2049, 2050, 2051, 2052, 2053, 2054, 2055, 2056, 2057, 2058, 2059, 2060, 2061, 2062, 2063, 2064, 2065, 2066, 2067, 2068, 2069, 2070, 2071, 2072, 2073, 2074, 2075, 2076, 2077, 2078, 2079, 2080, 2081, 2082, 2083, 2084, 2085, 2086, 2087, 2088, 2089, 2090, 2091, 2092, 2093, 2094, 2095, 2096, 2097, 2098, 2099, 2100, 2101, 2102, 2103, 2104, 2105, 2106, 2107, 2108, 2109, 2110, 2111, 2112, 2113, 2114, 2115, 2116, 2117, 2118, 2119, 2120, 2121, 2122, 2123, 2124, 2125, 2126, 2127, 2128, 2129, 2130, 2131, 2132, 2133, 2134, 2135, 2136, 2137, 2138, 2139, 2140, 2141, 2142, 2143, 2144, 2145, 2146, 2147, 2148, 2149, 2150, 2151, 2152, 2153, 2154, 2155, 2156, 2157, 2158, 2159, 2160, 2161, 2162, 2163, 2164, 2165, 2166, 2167, 2168, 2169, 2170, 2171, 2172, 2173, 2174, 2175, 2176, 2177, 2178, 2179, 2180, 2181, 2182, 2183, 2184, 2185, 2186, 2187, 2188, 2189, 2190, 2191, 2192, 2193, 2194, 2195, 2196, 2197, 2198, 2199, 2200, 2201, 2202, 2203, 2204, 2205, 2206, 2207, 2208, 2209, 2210, 2211, 2212, 2213, 2214, 2215, 2216, 2217, 2218, 2219, 2220, 2221, 2222, 2223, 2224, 2225, 2226, 2227, 2228, 2229, 2230, 2231, 2232, 2233, 2234, 2235, 2236, 2237, 2238, 2239, 2240, 2241, 2242, 2243, 2244, 2245, 2246, 2247, 2248, 2249, 2250, 2251, 2252, 2253, 2254, 2255, 2256, 2257, 2258, 2259, 2260, 2261, 2262, 2263, 2264, 2265, 2266, 2267, 2268, 2269, 2270, 2271, 2272, 2273, 2274, 2275, 2276, 2277, 2278, 2279, 2280, 2281, 2282, 2283, 2284, 2285, 2286, 2287, 2288, 2289, 2290, 2291, 2292, 2293, 2294, 2295, 2296, 2297, 2298, 2299, 2300, 2301, 2302, 2303, 2304, 2305, 2306, 2307, 2308, 2309, 2310, 2311, 2312, 2313, 2314, 2315, 2316, 2317, 2318, 2319, 2320, 2321, 2322, 2323, 2324, 2325, 2326, 2327, 2328, 2329, 2330, 2331, 2332, 2333, 2334, 2335, 2336, 2337, 2338, 2339, 2340, 2341, 2342, 2343, 2344, 2345, 2346, 2347, 2348, 2349, 2350, 2351, 2352, 2353, 2354, 2355, 2356, 2357, 2358, 2359, 2360, 2361, 2362, 2363, 2364, 2365, 2366, 2367, 2368, 2369, 2370, 2371, 2372, 2373, 2374, 2375, 2376, 2377, 2378, 2379, 2380, 2381, 2382, 2383, 2384, 2385, 2386, 2387, 2388, 2389, 2390, 2391, 2392, 2393, 2394, 2395, 2396, 2397, 2398, 2399, 2400, 2401, 2402, 2403, 2404, 2405, 2406, 2407, 2408, 2409, 2410, 2411, 2412, 2413, 2414, 2415, 2416, 2417, 2418, 2419, 2420, 2421, 2422, 2423, 2424, 2425, 2426, 2427, 2428, 2429, 2430, 2431, 2432, 2433, 2434, 2435, 2436, 2437, 2438, 2439, 2440, 2441, 2442, 2443, 2444, 2445, 2446, 2447, 2448, 2449, 2450, 2451, 2452, 2453, 2454, 2455, 2456, 2457, 2458, 2459, 2460, 2461, 2462, 2463, 2464, 2465, 2466, 2467, 2468, 2469, 2470, 2471, 2472, 2473, 2474, 2475, 2476, 2477, 2478, 2479, 2480, 2481, 2482, 2483, 2484, 2485, 2486, 2487, 2488, 2489, 2490, 2491, 2492, 2493, 2494, 2495, 2496, 2497, 2498, 2499, 2500, 2501, 2502, 2503, 2504, 2505, 2506, 2507, 2508, 2509, 2510, 2511, 2512, 2513, 2514, 2515, 2516, 2517, 2518, 2519, 2520, 2521, 2522, 2523, 2524, 2525, 2526, 2527, 2528, 2529, 2530, 2531, 2532, 2533, 2534, 2535, 2536, 2537, 2538, 2539, 2540, 2541, 2542, 2543, 2544, 2545, 2546, 2547, 2548, 2549, 2550, 2551, 2552, 2553, 2554, 2555, 2556, 2557, 2558, 2559, 2560, 2561, 2562, 2563, 2564, 2565, 2566, 2567, 2568, 2569, 2570, 2571, 2572, 2573, 2574, 2575, 2576, 2577, 2578, 2579, 2580, 2581, 2582, 2583, 2584, 2585, 2586, 2587, 2588, 2589, 2590, 2591, 2592, 2593, 2594, 2595, 2596, 2597, 2598, 2599, 2600, 2601, 2602, 2603, 2604, 2605, 2606, 2607, 2608, 2609, 2610, 2611, 2612, 2613, 2614, 2615, 2616, 2617, 2618, 2619, 2620, 2621, 2622, 2623, 2624, 2625, 2626, 2627, 2628, 2629, 2630, 2631, 2632, 2633, 2634, 2635, 2636, 2637, 2638, 2639, 2640, 2641, 2642, 2643, 2644, 2645, 2646, 2647, 2648, 2649, 2650, 2651, 2652, 2653, 2654, 2655, 2656, 2657, 2658, 2659, 2660, 2661, 2662, 2663, 2664, 2665, 2666, 2667, 2668, 2669, 2670, 2671, 2672, 2673, 2674, 2675, 2676, 2677, 2678, 2679, 26

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SOFTWARE: 1-DOS 4.2, C-W Basic, WordStar Advanced
Environment: Floures Dryers, Framersink III, 3-D Graphics

ATI and Computer-EEZ Tutorial Software, three hand disk.

manager, Pa Nish-11 Chromaster 2000, Splash VCA paint
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COMPROMISING RESOLUTIONS 8514 MONITORS BUILD ON VGA



You're not the only one who covets the sharp, detailed graphics displayed on the screens of high-priced computer-aided design (CAD) workstations. IBM, too, recognizes that there's no substitute for high-resolution images. To bring 1,000-plus lines—the generally accepted minimum for design work—to the PC mass market, IBM has developed the 8514 display system, comprising both a monitor designated by that number and the 8514/A display adapter.

Depending on who's talking, the 8514 system is either the next important standard in PC displays or a substandard system that offers too little for too much. According to those who hold the former view, the 8514 system offers a workable compromise between sharpness and cost. It achieves on-screen resolution high enough for true CAD use without demanding the

With an 8514/A display adapter and an 8514 monitor, your Micro Channel PS/2 system can achieve on-screen resolution that's good enough for CAD work. But does this new standard represent a truly workable compromise between sharpness and cost?

■ 8514 MONITORS

price of exotic display technologies. Those who hold the latter view say that 8514 is neither sharp nor cheap enough. It's not such a big step up from VGA, they contend, yet it costs more than a low-end Micro Channel system unit.

Which of the two views turns out to be correct will probably depend mostly on whether the compatibles industry takes up the 8514 standard. Competition should drive prices down and make 8514 the most affordable display system with real CAD potential.

Moreover, it will take the compatible manufacturers to move the 8514 system from PS/2s to classic bus PCs and ATs. The IBM 8514/A display adapter is available for only the Micro Channel, and IBM has renounced any plans to build an equivalent for the AT bus.

Whether the industry will embrace the full standard is still open to debate, but this review of 8514 displays shows that at least half the problem is nigh to being solved. Monitors capable of handling 8514 images are already available in force, and they add little if any price premium over the demands of ordinary VGA graphics. This is due in large part to the modest pretensions of the 8514 system, designed to be an affordable technical step above ordinary VGA resolution.

In fact, for many manufacturers of compatible displays, the extra cost of 8514 compatibility is just about nothing. All that the new monitor standard requires is a new cable. Both the horizontal and vertical scanning frequencies used by the 8514 system are well within the range of many existing multiscan displays. If you already own one with enough range, you can simply unplug it, slide its inputs over to your 8514/A display adapter, and put two and a half times as much information on your screen. You can also bet that those multiscan models that fall shy of the needed frequency reach are being tweaked by engineers to handle the new 8514 signals.

Under the real 8514 standard as promulgated by IBM (which offers no multiscan displays), backward compatibility with VGA is a necessary part of all 8514 displays. For instance, IBM's own 8514 display, although not truly a multiscan display, works under all the modes available with the VGA video standard. You can

plug an 8514—or an exact match from a compatibles manufacturer—into your computer's VGA system today. When you need (or can finally afford) the added resolution of the entire 8514 system, just buy the 8514/A display adapter, and you'll get better on-screen quality.

There's another side to the VGA compatibility of the 8514 standard. Unlike other IBM display systems, just adding in a new adapter is not enough to put higher resolution on your screen.

Without specially written software, 8514 displays act as though they were ordi-

Without specially written software, 8514 displays act like ordinary VGA monitors and the higher resolution of the new system is wasted.

nary VGA monitors. Their higher resolution comes into play only when the applications that you're using take advantage of the special features of the 8514 system. Run your favorite word processor or spreadsheet, for example, and you'll be looking at an ordinary VGA image on a much more expensive display. If you don't have software that calls for an 8514 display system or you don't plan on buying any, the higher resolution of the new system will be wasted.

The 8514 display system can also operate in conjunction with the VGA built into your PS/2 and your VGA monitor. When you run ordinary VGA software, both your 8514 and VGA monitor will display the same image. Once you shift into 8514 mode, the 8514 will show its high-resolution image independently of your VGA display. Programs can be written to put one image on the VGA display and another on the 8514, both in full color, for a true two-display system.

THE EVER-EVOLVING PIXEL More than the 8514 display, the heart of the new IBM video system is the 8514/A display adapter. The 8514/A sets all the operating parameters of the system, determines its resolution, and offers a unique program interface.

From the standpoint of the display, however, the 8514/A display adapter looks like a simple extrapolation of the VGA system. As with VGA, the 8514 system uses analog signals. Under both the VGA and 8514 standards, the analog video signals vary from zero volts (which leaves the screen black) to 0.7 volts for full intensity on the screen. The new standard is built around the same digital-to-analog converter (DAC) that allows for 256 different colors on the screen, drawn from a potential palette of 262,144, when the 8514/A adapter is topped off with its full memory quota. As with VGA, the 8514 video system also allows for monochrome displays, automatically mapping colors to 64 shades of gray on the screen.

The 8514 standard differs from VGA in its resolution. Where VGA systems operate at four resolutions—640 by 350 pixels for compatibility with EGA software, 640 by 400 pixels for compatibility with CGA software (by double scanning 640 by 200 pixel images), 640 by 480 pixels for VGA graphics, and 720 by 400 pixels for VGA text—the 8514/A display adapter adds an additional level, 1,024 x 768 pixels. The increased resolution results in a 250 percent increase in the number of pixels on the screen, from 307,200 in VGA graphics mode to 786,432 with the 8514 standard. That increase demands a wider bandwidth from the 8514-compatible displays, because the dot-clock frequency has moved up from the 25 MHz used for the VGA to 44 MHz for 8514.

Note that many of the displays reviewed here claimed bandwidths more modest than the demands of the 8514 dot clock. Several manufacturers list the maximum on-screen resolution of their products as somewhat less than that of the 8514 display system. In theory, such a shortfall should result in a lack of on-screen sharpness. The edges of lines and characters should appear less well-defined, even fuzzy.

In testing, however, none of these dis-

plays demonstrated an obvious inferiority attributable to inadequate bandwidth. Only when we minutely examined the screen did differences become discernible, and in every case these differences were less noticeable than the misalignment (misconvergence) of the display. In all of the 8514-compatible displays reviewed here, convergence—not bandwidth—appears to be the major obstacle to on-screen sharpness when operating under the 8514 standard.

SCANNING WITH PERSISTENCE

Beyond bandwidth, the 8514 system also requires different vertical and horizontal frequencies than are used by the VGA standard. The horizontal scanning frequency is stepped up from VGA's 31.47 kHz to 35.52 kHz in the 8514 standard. The change in vertical rate is more complex. The 8514 standard reduced the vertical frequency (frame rate) to 43.48 Hz from the 59.94 Hz used by VGA. But 8514 displays are interlaced, so the actual image is vertically swept twice for each frame. All other IBM displays are not interlaced.

An interlaced display scans down the face of the tube twice for each image frame it displays. Each time it scans down, it traces out every other scan line. On the first pass, it might illuminate the odd-numbered scan lines; on the second pass, it will scan even-numbered lines.

Interlacing permits greater on-screen resolution with narrower bandwidth signals. Minimizing bandwidth is important because once the dot clock gets much higher than that used by the 8514 standard, the normal transistor-transistor logic (TTL) circuits used in the PC are not good enough. Emitter-coupled logic (ECL) chips must be used instead, and they are expensive both in cost and in the power they require.

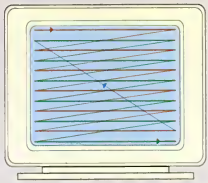
One way of trimming the signal bandwidth is to lower the frame rate, or refresh frequency, by the same number of times per second that the image is being scanned. The frame rate of any video standard is inevitably a compromise. Cost considerations argue for a low frame rate. Quality demands a higher rate. The frame rate cannot be made too low, because when it falls below 50 or 60 Hz, you can see the on-



Screen Sweeps: 8514 vs. VGA

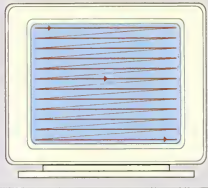
Interlaced display

An interlaced display system such as the 8514 scans alternating lines of the screen using two passes to produce the whole image. Each pass occurs in $1/60$ second, producing a complete image in the same $1/60$ second a noninterlaced display would take. If the phosphors that were illuminated in the first pass do not persist long enough for the second pass's lines to be drawn, the screen will appear to flicker.



Noninterlaced display

A noninterlaced display system such as the VGA traces each scan line in succession from top to bottom. This procedure is accomplished in less than $1/60$ second, so the viewer perceives the image as a whole before it is altered.



screen image being traced.

Interlacing makes this phenomenon less obvious because double scanning the image apparently increases the frame rate by a factor of two. Instead of 44 Hz, the interlaced 8514 display appears to have a frame rate of 88 Hz.

Interlaced images may still flicker—the perception of flicker is quite subjective and varies from person to person—and the effect is most noticeable when the screen is viewed at close range. To eliminate the last trace of flicker, manufacturers often use medium- or long-persistence phosphors. For example, IBM chose medium-persistence phosphors for its 8514 display.

Phosphor dots on most video screens glow only a few milliseconds longer than the period during which they are struck by the scanning electron beam in the display tube. (The beam itself lingers over dots but briefly—about 35 nanoseconds in most VGA modes and only 22 ns. under the 8514 standard.) Long-persistence phosphors may stretch the time of that glow to 100 ms. or more, holding the light over the flash of several frames (which, under the 8514 standard, last about 23 ms. each).

Long-persistence phosphors have their own problems. They don't glow as brightly as short-persistence phosphors, resulting in dimmer screens. And their images

■ 8514 MONITORS

decay so slowly that they can leave ghostly trails on the screen. With long-persistence phosphors you trade one irritation (flicker) for another (image lag).

SOFTWARE CONSIDERATIONS
From the standpoint of your programs, the 8514 video system appears entirely unlike anything IBM has marketed before. Instead of using BIOS instructions or direct movement of data into display memory, the 8514 system incorporates its own higher-level language called the Application Interface. This language allows the 8514/A to take over some of the work usually left to the host system's microprocessor. For instance, instead of making the microprocessor calculate every dot on a line to be drawn across the screen, the 8514/A will draw the line itself from a few relevant parameters supplied by the host system. In effect, the 8514/A acts like a display coprocessor, speeding up not only the rate at which images are drawn but also the entire computer, because its labors are favorably divided.

The 8514/A Application Interface is at its best in CAD applications. However, the display adapter also includes support for proportionally spaced and downloadable fonts that will likely prove handy in desktop publishing and related applications.

IBM intends to make the Application Interface of the 8514/A into an industry standard. That means that future products (at least those from IBM) should also use the same instructions to accomplish the same on-screen purposes. New, higher-resolution products (such as those that do away with pesky interlacing) can be created that will remain compatible with software written to use the 8514/A Application Interface. Moreover, manufacturers of display adapters compatible with the 8514/A should not have to worry about exactly duplicating IBM's hardware; compatibility with the Application Interface should be all that's necessary—at least in theory.

Unfortunately, the Application Interface is not uniformly fast at everything. For many operations the old-fashioned way of doing things—moving bytes directly into video memory—is much faster than going through the interface. (Some sources indicate that direct writing aver-

ages four to five times quicker.) Consequently, what may be the most important 8514/A application, the OS/2 Presentation Manager, will sidestep the Application Interface.

Because of the design of OS/2, however, the failure of Presentation Manager to use the Application Interface does not mean the manufacturers of 8514/A-compatible display adapters will have to exactly duplicate the IBM hardware. Under the

**The 8514 standard
as it exists now pushes
many 8514-style displays
to their limits. It
appears to be a
development plateau
rather than a final goal.**

OS/2 model, driver software will help any hardware product achieve Presentation Manager compatibility.

From the standpoint of buying an 8514 display, the display adapter interface situation is a mixed blessing. Display adapter manufacturers that elect to transcend the interlacing of the 8514/A yet maintain software compatibility through the Application Interface may make products that require higher bandwidths and won't work with today's 8514-style displays that lack multiscan abilities.

Then again, the 8514 standard as it exists now pushes many such displays to their limits. The 8514 standard appears to be a development plateau rather than a final goal. Nevertheless, it's probably a safe investment for at least the next year or two.

STANDARD SIGNALS The 8514 display standard goes beyond dots and Hertz, however. Under the IBM standard, both the monitor and the display adapter have

means of signaling to the other its identity. The monitor uses a set of three special connections on its interface cable. Combinations of these signals indicate whether the connected display is an 8503 monochrome display, 8513, 8512, or 8514 color display. From these signals the 8514/A display adapter knows what colors and frequencies the display can handle, and it won't send out anything that's incompatible with the display.

At the other end of the connection, the display adapter signals to the display its operating mode by changing the polarities of its vertical and horizontal synchronizing signals. This indication tells the display the number of lines in the displayed image so that the display can properly adjust the size of the image.

The 8514/A display adapter supports images made from four different numbers of lines. Its EGA-compatible mode operates with 350 lines. Both its double-scanned CGA-compatible and VGA text mode operate with 400 lines. VGA graphics images are made with 480 lines. And 8514/A images have 768 lines.

If the display doesn't adjust to the varying number of lines in the on-screen image, graphics may take odd shapes because the aspect ratio of the screen may drastically change. For instance, whereas a circle drawn in the 768-line mode of the 8514/A would look perfectly round, in the 350-line VGA mode that circle would turn into a flat ellipse. The sync signaling scheme allows the display to shift its vertical gain (which determines how tall the on-screen image is) to correspond to its operating mode and keep shapes consistent.

Some displays do not follow the IBM sync signaling scheme but rely on other methods to properly adjust the height of the on-screen image to reflect the operating mode. Some displays make no allowance for the various operating modes.

If you frequently shift between modes, you probably won't like working with this last kind of display. If you choose a mode and stick with it—for instance, if all you do is run a design program all day—you may not be bothered by such shortcomings, particularly should the display make height and width controls available to you for trimming the image size and the aspect ratio.

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■ 8514 MONITORS

Used wisely, vertical and horizontal size controls (also known as height and width) can help you adjust the image on a display screen to your taste. Some people prefer making the image as large as possible so that it nearly spills over the edges of the bezel. With many displays, however, a more modest image size looks more geometrically accurate. The inevitable curvature of the screen can make lines near the screen edge look distorted. Reigning in the image helps ensure against odd-looking images. If you don't have size controls, your flexibility is limited. You must accept the image as it was set up at the factory.

Horizontal and vertical positioning controls allow you to move the active im-

**As with any display
standard, the size of the
monitor you choose
depends more on your
application and personal
preference.**

age area across the face of the display tube; for instance, you can adjust it so that the black border is the same width on every edge. If a display is properly set up at the factory, such controls might be superfluous, but their absence can leave you short on flexibility.

CHOOSING A DISPLAY As with any display standard, the size of the monitor you choose depends more on your application and personal preference than on any technical consideration. Most CAD systems tend toward having larger displays, and the 8514 display itself measures a generous 16 inches diagonally. Using bigger displays helps make details clearer. Extremely large displays can dominate a desk, however. They may not be desirable for typical business applications, because you may have to sit far back from your

desk in order to view them more easily.

Available 8514-compatible displays span a wide range of screen sizes. The smallest produce an image that measures little more than 11 inches diagonally. The largest use 20-inch tubes, giving more than twice the viewing area across 17 inches of active display.

COLOR OR MONOCHROME? As with VGA, the 8514 standard is not restricted to color displays but allows the use of monochrome monitors almost interchangeably. For applications in which color is not critical (such as desktop publishing), a monochrome display can be an excellent choice. Single-color systems are not only substantially less expensive, costing about \$350, but also should be relatively free from image problems.

The 8514-compatible displays reviewed here varied not in color capability or on-screen resolution but more in the quality of their images and the compatibilities they offered. For CAD applications image geometry and aspect ratio are critical to ensuring that the shapes you see represent exactly what your software draws. Alignment is an indication of the care and quality of construction. It also limits the maximum resolution of the display.

These displays vary most in the compatibilities they offer. All will work with IBM's 8514/A display adapter and with VGA video signals. Some will also operate with old-style digital signals (CGA and EGA) as well as with proprietary higher-resolution signals. Which of these compatibilities you need will be determined by what application you're going to use it for.

AYDIN CONTROLS Aydin Controls Patriot VGA/20

Like a great stone face, the front of the Aydin Controls Patriot VGA/20 looms, a flat slab in front of a cube of electronics. The American-made \$2,395 VGA/20 looks larger than its 18½- by 19- by 19-inch (HWD) dimensions would imply. The bulky look is emphasized by the wide belt below the 20-inch (diagonal) display tube. An optional tilt-swivel adapter is available to push the VGA/20 further skyward.



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■ 8514 MONITORS

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DONOUGH



The squarish styling of the American-made \$2,395 Aydin Controls Patriot VGA/20 makes it look larger than its 18½-by-19-inch (HWD) dimensions. An analog-only display, it conforms with the three VGA modes as well as 8514/A.

The plastic case of the VGA/20 is finished in light beige except for the wide gray bezel that surrounds the dark gray screen that's tinged with green. An anti-glare coating improves image contrast. Rack-mount and rectangular metal utility cabinet versions of the VGA/20 are also available. The VGA/20 earns only a Class A (business use) FCC certification.

An analog-only display, the Patriot VGA/20 conforms with the three VGA modes (350-line EGA-compatible, 400-line CGA-compatible and VGA text, and 480-line VGA graphics) as well as

8514/A. It accepts three discrete vertical scanning frequencies—60, 70, and 87 Hz—and horizontal scanning frequencies from 31.5 to 35.5 kHz.

One input connector is provided on the rear panel, a 9-pin D-shell. A removable cable (5-feet long) adapts the input of the Patriot VGA/20 to the 15-pin, high-density D-shell connector used by VGA- and 8514/A-style display adapters.

AUTOMATIC IMAGE-SIZING Per the 8514 standard, the Patriot VGA/20 automatically determines its operating mode

from sync polarity and properly sizes its image. For instance, we measured less than a ¼-inch (diagonal) difference in CGA-compatible and 8514/A image sizes.

Neither image size nor position can be adjusted by the user. The VGA/20 delivered a 17¼-inch image (diagonal) across the 19 inches of the visible screen face. This image was centered on the screen, geometrically accurate, and close to perfect in alignment (alignment errors in corners approached 1 millimeter).

The 0.31-mm dot pitch and 40-MHz bandwidth of the VGA/20 assure a sharp image. Its maximum claimed resolution matches the 8514/A standard, 1,024 by 768 pixels. Although the brightness of the set proved somewhat limited, its sharpness was maintained throughout its entire illumination range. No image flare was apparent at high drive levels.

The one area the Patriot VGA/20 skimps on is controls. On the front panel, what looks like a single knob controls both brightness and contrast; the former is a thin, hard-to-grasp concentric ring around the solitary knob. A small rocker switch behind the top-right of the screen controls power; on the left side is a rocker switch that activates the degaussing circuitry. In addition to the power and signal input connectors, a single fuseholder completes the rear panel of the VGA/20.

Overall, the Patriot VGA/20 is a good alternative to IBM's 8514 for those who want a big display.



FACT FILE

Aydin Controls Patriot VGA/20

Aydin Controls
414 Commerce Dr.
Fort Washington, PA 19034
(215) 542-7800

List Price: Model 8921, with video interface cable: \$2,395; Aydin VGA/1024 card, \$695; tilt-and-swivel base, \$175; plastic case, \$150; neck mount, \$110.

Requires: Any VGA or 8514/A display adapter or compatible.

In Short: A big-screen (20-inch tube) color display capable of handling all IBM graphics modes. Offers a bare minimum of controls for brightness, contrast, and power.

CIRCLE 887 ON READER SERVICE CARD

ELECTROHOME LTD.

Electrohome ECM-1910

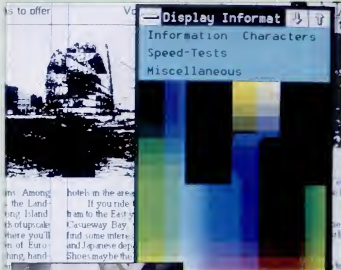
A big screen requires a big case, and the case of the Electrohome ECM-1910 measures a squat 17 by 19 by 19 1/2 inches (HWD), when sitting flat on a desktop. (An optional tilt-swivel adapter for the \$2,895 display costs \$106.) The pale beige plastic case, accented by a gray bezel around the screen, has earned FCC Class B certification.

A true multiscan display, the Japanese-made ECM-1910 accepts signals with vertical scanning frequencies from 47 to 85 Hz and horizontal frequencies from 15 to 34 kHz. Both analog and digital inputs are provided with a separate 9-pin D-shell socket for each. A rear-panel slide switch determines which of the two is active at any time.

To connect the analog connector to a standard VGA or 8514/A output, Electrohome supplies an adapter cable measuring 74 inches long, terminating in a 15-pin, high-density D-shell. This cable proved interesting in itself: it's made from five separate, thin coaxial cables bundled together.

ELABORATE SET OF CONTROLS

To accommodate the various video standards that the ECM-1910 is capable of handling, Electrohome has placed a rather elaborate set of image-size and -position controls on the monitor's rear panel. A matrix of 16 screwdriver-adjusted controls



A true multiscan display, the Japanese-made Electrohome ECM-1910 measures a squat 17 by 19 by 19 1/2 inches (HWD) when sitting flat on a desktop. The monitor is capable of accommodating various video standards, costs \$2,895, and has earned FCC Class B certification.



FACT FILE

Electrohome ECM-1910

Electrohome Ltd.
809 Wellington St. North
Kitchener, Ontario N2G 4B6
Canada
(519) 749-3158

List Price: \$2,895; tilt-swivel base, \$106;
VGA and PS/2 cable, \$99

Requires: Any 8514/A or PS/2 display
adapter or compatible.

In Short: A 19-inch multiscan color display,
with both analog and digital inputs, that's
compatible with the 8514/A display adapter
and features a wide variety of user controls.

CIRCLE 606 ON READER SERVICE CARD

handles both horizontal and vertical size and position for each of four operating modes, as defined by the synchronizing frequencies in the display's input signal. A horizontal frequency of 15 to 16.5 kHz sets CGA mode; 18 to 23 kHz sets EGA mode; 28 to 34 kHz sets VGA (which includes PGC and 8514/A) mode; and 24 to 26.5 kHz defines a fourth, non-IBM mode.

All VGA and 8514/A signals are handled by one mode and one set of size controls. The ECM-1910 monitor does not automatically size its image based on sync polarity. As a result, the image size of only one of the four possible image types al-

lowed under VGA and 8514/A (350, 400, 480, and 768 lines) can be properly set. The shapes of other image types will vary, with some odd aspect ratios appearing on the screen.

With 8514/A video, the best image we obtained measured 16 1/4 inches (diagonally) across the 18 1/4-inch visible area of the 19-inch display tube. When the image was made larger by increasing its height, the top few display lines began to fall apart, breaking into differently colored lines.

When overscan mode was activated by a rear panel push button, the image extended beyond the confines of the screen bezel

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■ SO2Plus 1.11	59.
■ 4Word 2.0	59.
■ Q & A Write 1.01	119.
■ Grandview 1.0	175.

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If your workload's appalling

*And the tax man is calling,
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□ Q & A 3.0 (database, word processor) . . .	\$209.
□ Breakthrough Timeline 3.0 . . .	349.
□ Spreadsheet Analyst 2.5 . . .	89.
□ Note-It Plus 1.02 . . .	49.
□ Think Tank 2.4NP . . .	115.
□ Q&A Network Pak 1.0 (requires Q&A) . . .	179.

T/Maker ... NCP	
□ Scrapbook + 1.0 . . .	79.
□ ClickArt Business Images . . .	42.
□ ClickArt Holidays . . .	42.
□ EPS (PostScript) Illustrations . . .	79.
The XTRÉE Co. ... NCP	
□ XTRÉE Pro 1.0 . . .	69.
□ Hot 4.0 . . .	95.

TOPS ... NCP	
Flashcard (AppleTalk network card; 1 year warranty) . . .	169.
NetPrint 2.0 (share printers) . . .	119.
TOPS 2.0 . . .	119.
TOPS Repeater (extends network) . . .	132.

Traveling Software ... NCP	
Battery Watch 1.0 (3 1/2" only) . . .	27.
□ Laplink Mac 2.0 (Mac-PC transfer) . . .	79.
□ Laplink Plus 2.1 . . .	85.
□ Desklink 2.21 . . .	99.

True BASIC, Inc. ... NCP	
□ True BASIC 2.03 (now includes Runtime) . . .	57.
□ True Basic Libraries . . .	32.

Vericomp ... NCP	
□ SoftBytes 2.0 . . .	35.
□ SoftBytes 386 2.53 . . .	49.

WordPerfect Corp. ... NCP	
□ WordPerfect Library 2.0 . . .	69.
□ WordPerfect 5.0 . . .	239.
□ WordPerfect 5.0 Add'l Network Stations . . .	84.
□ WordPerfect Office 2.0 . . .	269.
□ WordPerfect Office 1.0 Add'l Network Stations . . .	84.

□ WordPerfect Network Server 5.0 . . .	349.
□ WordPerfect Executive . . .	129.

Wordtech ... NCP	
□ DBXL 1.2 . . .	119.

Xerox ... NCP	
□ Ventura Publisher 2.0 . . .	call

XyQuest ... NCP	
□ XyWrite III Plus 3.54 w/A-la-Carte Menus . . .	239.
□ XyWrite III Plus Network Server 3.54 . . .	399.

RECREATIONAL/EDUCATIONAL

Accolade ... CP (reqs. graphics brd.)	
□ Bubble Ghost . . .	22.
□ Mean 18 . . .	29.
□ Hardball (baseball simulation) . . .	11.
□ Testdrive (driving simulation) . . .	24.
□ Jack Nicklaus' 18 Greatest Holes . . .	29.
□ Grand Prix . . .	22.

PC Connection Hardware Special

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With Mindscape ... CP**

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The recreational starter kit that's just right for your PC.

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- Mindscape's Colony - a spectacular 3-D animated Sci-Fi adventure where you are a regional marshal battling hostile aliens

Kraft Premium 3-Button Joystick . . .	\$33.
Kraft High Speed Adapter Card . . .	25.
Mindscape's Colony 1.0 . . .	30.
Buy all three for just . . .	59.
Or buy just the joystick and Colony for . . .	79.

□ 4th & Inches (football simulation) . . .	\$22.
--	-------

Broderbund ... CP

□ Where in the World is Carmen SanDiego? . . .	25.
□ Where in the USA is Carmen SanDiego? . . .	25.
□ Where in Europe is Carmen SanDiego? . . .	29.
□ Toy Shop . . .	39.
□ Ultima IV . . .	35.
□ Ultima V . . .	39.

Electronic Arts ... CP (reqs. graphics brd.)

□ One-on-One/Bird vs Jordan . . .	29.
□ Chuck Yeager's Flight Simulator . . .	29.
□ Chessmaster 2100 . . .	35.
□ Earl Weaver Baseball . . .	35.
□ Empire . . .	35.
□ Mavis Beacon Teaches Typing . . .	35.
□ Sentinel Worlds . . .	39.
□ Grand Slam Bridge . . .	45.

Infocom ... NCP

□ Zork Trilogy . . .	33.
Microprose ... CP	
□ F-19 Stealth Fighter (requires CGA or EGA) . . .	39.
□ F-15 Strike Eagle (requires CGA) . . .	22.
□ Gunship (requires CGA or EGA) . . .	32.

Microsoft ... NCP

□ Flight Simulator 3.0 (reqs. graphics brd.) . . .	35.
Mindscape ... CP	
□ Colony 1.0 . . .	special

One Step Software ... NCP

□ Golf Doctor 1.1 (improve your game) . . .	\$33.
□ Golf's Best Pinehurst #2 4.0 (play the best) . . .	12.
□ Golf Statkeeper 1.0 . . .	
(includes USGA Handicapper) . . .	27.

19th Hole Special

(3 Golf programs above bundled with Mr. Boston Micro Bartender's Guide) . . .	79.
□ Mr. Boston Official Micro Bartender's Guide . . .	18.
□ Micro Video Companion 1.0 . . .	24.
□ Take Control of Cholesterol 2.0 . . .	24.

Parlor Software ... CP

□ Bridge Parlor 2.3 (best Bridge simulation) . . .	49.
Sierra On-Line ... CP	
(All require Hercules, CGA or EGA)	
□ Leisure Suit Larry . . .	25.
□ Space Quest II . . .	33.
□ King's Quest IV (512k version) . . .	33.
□ Manhunter . . .	33.
□ Police Quest . . .	33.
□ Police Quest II . . .	33.
□ Leisure Suit Larry II . . .	33.
□ 3D Helicopter . . .	33.

Simon & Schuster

□ Star Trek: Rebel Universe . . .	29.
Sphere, Inc. ... NCP	
□ Orbiter (shuttle simulation) . . .	27.
□ GATO (submarine simulation) . . .	12.
□ Tetris (addicting mind teaser) . . .	24.
□ Falcon (F-16 simulation, reqs. graphics brd.) . . .	32.

Spinnaker ... CP

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□ Kids on Keys (ages 3 to 9) . . .	19.
□ Facemaker Gold (ages 3 to 8) . . .	25.
□ Kindercomp Gold (ages 3 to 8) . . .	25.
□ SAT Preparation Program . . .	25.
□ Kidwriter Gold (ages 6 to 10) . . .	32.
□ Homework Helper—Math (grades 7-12) . . .	32.
□ Homework Helper—Writing (grades 7-12) . . .	32.

Stone & Assoc. ... NCP (reqs. graph. brd.)

□ Algebra Plus (ages 13 to adult) . . .	27.
□ Memory Master (ages 2 to 6) . . .	27.
□ My Letters, Numbers, Words (2 to 6) . . .	25.
□ Second Math (ages 7 to 16) . . .	27.

Sublogic ... NCP

□ Jet 2.1 (requires EGA or CGA) . . .	33.
□ Scenery Disks . . .	each 15.
□ San Francisco Star Scenery Disk . . .	18.
□ Japan Scenery Disk . . .	15.
The Learning Company ... CP	
□ Math Rabbit (ages 4 to 7) . . .	26.
□ Reader Rabbit (ages 4 to 7) . . .	26.
□ Writer Rabbit (ages 6 to 12) . . .	26.

True BASIC, Inc. ... NCP

□ Kemeny/Kurtz Math Series . . .	32.
XOR ... NCP	
□ NFL Challenge 2.0 . . .	69.

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HARDWARE

Manufacturer's standard limited warranty period for items shown is listed after each company name. Some products in their line may have different warranty periods.

AST Research ... 2 years	
I/O Mini 2 C/S/P	\$89
SixPakPlus 64k C/S/P (upgrades to 576k)	129.
Advantage Premium 512k S/P (upgrades to 1 Meg or 2 Meg w/Piggyback)	call
Advantage 2-386 (for PS/2 Model 80)	call
RAMPage Plus 286 512k (for XT/286/AT)	call
RAMPage! Plus MicroChannel 512k (for PS/2 Models 50/60)	call
Amdek ... 90 days	
LaserDrive-1 (external CD-ROM Drive)	629
LaserDrive-2 (internal CD-ROM Drive)	629
Computable ... 2 years	
2-Position switch box	29
3-Position switch box	39
Cuesta ... 1 year	
Datasaver 400 Watt (standby power backup unit for the AT)	459
Curtis ... lifetime	
ACCESSORIES	
Curtis Clip CC-1	6.
Disk Holder DB-1 (holds 50 5 1/4" disks)	8
3 1/2" Disk Holder DB-2 (holds up 40 disks)	8
3 1/2" Diskette Cleaning Kit CK-2	16.
Printer Stand PS-1	18
Universal System Stand SS-3	25.
Static Mat SM-2	25.
ToolKit TK-1	25.
DS-1 Switch Box (controls 2 printers)	33.
CABLES	
Smartmodem-to-PC Cable EC-7 (9 feet)	17.
Printer-to-IBM cable EC-6 (9 feet)	17.
PS/2 Keyboard Extension Cable EC-9	25.
Keyboard Extension Cable EC-2	25.
SURGE SUPPRESSORS	
Safesurf SP-3 (6 outlets; 1 year warranty)	19.
Filtered Safesurf SP-3	21.
Diamond SP-1 (6 outlets)	29
Emerald SP-2	36.
Diamond Plus SP-1 Plus	41.
Sapphire SP-1	45.
Ruby SPF-2 (6 outlets; EMI/RFI filtered, 6 ft cord)	55.
Ruby-Plus SPF-2 Plus (w/FAX & modem protection)	69
DCA ... 1 year	
Irma 2 Micro Channel (for PS/2 Models 50/60/70/80)	729

PC Connection Hardware Special

through February 28, 1989

Microsoft ... lifetime The New Microsoft Mouse

Microsoft has built a better mouse with an all new look and feel. With over one million Microsoft mice now in use, it is easy to see the popularity of performance. Choose among one of the following three software bundles with either a Bus or Serial/PS/2 interface

- EasyCAD, a two-dimensional computer-aided design program
 - Microsoft Paintbrush and Mouse Menus
 - Microsoft Windows 286 and Microsoft Paintbrush for Windows (specify Bus or Serial/PS/2 interface)
- | | |
|---|--------|
| Mouse with EasyCAD | \$121. |
| Mouse with Microsoft Paintbrush and Menus | 105 |
| Mouse with Windows 286 and Microsoft Paintbrush for Windows | 139 |

Irma 2 (3270 emulation board) ... \$729.

Epson ... 1 year

We are an authorized Epson Service Center.

- | | |
|---|------|
| FX-850 (80 col., 264 cps, 9 pin) | call |
| FX-1050 (136 col., 264 cps, 9 pin) | call |
| LQ-500 (80 col., 180 cps, 24 pin) | call |
| LQ-850 printer (80 col., 264 cps, 24 pin) | call |
| LQ-1050 printer (136 col., 264 cps, 24 pin) | call |
| LQ-2550 printer (136 col., 400 cps, 24 pin) | call |
| LX-800 printer (80 col., 180 cps, 9 pin) | call |
| Printer-to-IBM cable (6 feet) | 15. |

Everex ... 1 year

- | | |
|----------------------------------|------|
| 1200 Baud Internal Modem | 79. |
| 2400 Baud Internal Modem | 149. |
| 5th Generation ... 1 year | |
| Logical Connection 256k | 449. |
| Logical Connection 512k | 499. |

Hayes ... 2 years

- | | |
|-------------------------------------|------|
| Personal Modem 1200 | 145 |
| Smartmodem 1200 | 299. |
| Smartmodem 1200B (with Smartcom II) | 299. |
| Smartmodem 1200B (hardware only) | 265. |

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Smartmodem 2400	\$49.
Smartmodem 2400B (with Smartcom II)	449.
Hercules ... 2 years	
Graphics Card Plus	189.
Network Card Plus (with TOPS DOS)	339.
Incolor Card	229.
Intel ... 5 years	
2400B Modem (internal modem for IBM-PC/XT/AT)	249.
2400B Modem 2 (internal modem for PS/2 Models 50/60/80)	269.
Inboard 386/PC w/1 Meg	729.
Inboard 386/PC Piggyback Card w/4 Meg	1699.
Inboard 386/AT 0/k (req. installation kit)	899.
Inboard Installation Kit (specify computer)	139.
Above Board Plus 512k	special
Above Board 2 Plus 512k	special
Above Board Plus I/O 512k	special
Connection Coprocessor (FAX board plus)	769.
Optional 2400 Baud Modem for Connection Coprocessor	229.
MATH COPROCESSORS	
8087 (for IBM-PC & XT)	105.
8087-2 (8 MHz; for PS/2 Models 25 & 30)	149.
80287 (for AT & XT/286)	165.
80287-8 (for 8 MHz 80286 machines)	239.
80287-10 (for PS/2 Models 50 & 60)	279.
80387 (for 16 MHz PS/2 Model 80)	439.
80387-20 (for 20 MHz PS/2 Model 80)	499.
Kensington Microwave ... 1 year	
Masterpiece	94
Masterpiece Plus	109.
Keytronic ... 3 years	
101 Plus Keyboard (enhanced layout)	99.
101 Plus Keyboard	99.
Kraft ... 5 years	
Three-button Joystick	special
High Speed Joystick Adapter Card	special
Adapter Card/3-Button Joystick Bundle	49.
KYE International ... lifetime	
Dyna Mouse GM6+ (w/Ox Halo II)	54.
Logitech ... lifetime	
Series 2 Mouse (for PS/2 50/60/70/80)	65.
HIREZ Mouse (bus only)	89.
Mouse w/Paint Show (bus or serial)	95.
Mouse w/LogCAD (bus or serial)	119.
ClearCase Mouse (serial only)	99.
ScanMan (hand held scanner)	199.
Microsoft ... 2 years	
Mach 20 (1 year warranty)	349.
Disk + Option (for Mach 20; 1 yr wty)	69.
Memory + Option (for Mach 20; 1 yr wty)	339.
Mouse with Paintbrush (bus or serial)	special
Mouse with EasyCAD (bus or serial)	special
Mouse with Windows/286 (bus or serial)	special

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*DEFECTIVE SOFTWARE REPLACED IMMEDIATELY. DEFECTIVE HARDWARE REPLACED OR REPAIRED AT OUR DISCRETION.

So bring on the snow!

*And let those winds blow!
Your hottest Connection's
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MSC Technologies ... lifetime

OmniMouse (serial only; 1 year warranty) ..	\$57.
PC Mouse II w/PC Paint+ (bus or serial) ..	89.
PC Mouse II w/Autosketch (bus or serial) ..	105.

NEC ... 2 years

Multisync II (800 x 560 max. resolution) ..	599.
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NSI Logic ... 3 years

Smart VGA (supports full VGA specs) ..	239.
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Orchid Technologies ... 2 years

Tiny Turbo 286 (accelerator board) ..	289.
ProDesigner VGA (800x600 VGA Mode) ..	319.
RAMQuest Xtra 16/32 Kb ..	339.

PC Power & Cooling Systems ... 1 year

REPLACEMENT POWER SUPPLIES

Turbo Cool 150 (run 25° - 40° cooler) ..	129.
Turbo Cool 250 (run 25° - 30° cooler) ..	169.
Silencer 150 (64% noise reduction) ..	115.
Silencer 200 (69% noise reduction) ..	149.
Turbo Cool 375 ..	299.

PC Support Group ... 1 year

Breakthrough 286 Accel. Board (8 MHz) ..	299.
Breakthrough 286 Accel. Board (12 MHz) ..	449.

Practical Peripherals ... 5 years

1200 Baud Internal Modem (w/ProComm) ..	69.
1200 Baud External Modem (mn) ..	79.
PILink (parallel line extender/32k) ..	109.
Microbuffer Inline (par. print buffer/32k) ..	135.
2400 Baud Internal Modem ..	159.
2400 Baud External Modem ..	189.

Princeton Graphics ... 1 year

Ultrasync (supports CGA, EGA, VGA) ..	549.
Max 15 Monochrome Monitor ..	289.

Safe Power Systems ... 2 years

Safe 250W (standby power backup) ..	249.
Safe 425W (standby power backup) ..	369.

Toshiba ... 1 year

F321SL printer (80 cpi, 216 cps, w/factory) ..	529.
T1000 Laptop (80C86, 6.4 lbs., 5 hr. battery) call	
T1000 Laptop (80C86, 10 MHz, 20 Meg) ..	call
T1200HB Laptop w/Backlit screen ..	call
T1200FB Laptop Dual Floppy System w/Backlit screen ..	call
T3100/20 Laptop (80286, 8 MHz, 20 Meg) ..	call
T3200 Laptop (80286, 12 MHz, 40 Meg) ..	call
T5100 (80386, 16 MHz, 40 Meg) ..	call
768k RAM Card for T1000 ..	299.

Video 7 ... 5 years

VEGA Deluxe (supports 640x480) ..	219.
VEGA VGA (supports full VGA specs) ..	287.
FastWrite VGA ..	379.
VRAM VGA ..	529.

DRIVES

Alloy ... 1 year

Tape System/2 (for PS/2 MicroChannel) ..	299.
Retriever/40 (for IBM AT & compatibles) ..	349.

IOMEGA ... 1 year

Dual 20 Meg Bernoulli Box (8") ..	\$1679.
20 Meg Cartridge (8") ..	82.
20 Meg Tipak (8") ..	244.
Bernoulli II Single 20 Meg Internal (5 1/4") ..	767.
Bernoulli II Dual 20 Meg External (5 1/4") ..	1659.
20 Meg cartridge (5 1/4") ..	59.
20 Meg Tipak (5 1/4") ..	169.
PC2 Card ..	169.
PC2B Card (bootable card for PC/XT/AT) ..	229.
PC4 Card (for PS/2 Model 50/60/70/80) ..	299.

Mountain Computer ... 1 year

40 Meg Internal Tape Drive (XT, AT or PS/2) 379.	
40 Meg External Tape Drive (XT, AT or PS/2) ..	479.
40 Meg External Tape Drive w/Power Supply (XT, AT, or PS/2) ..	569.

Plus Development ... 2 years

Hardcard 20 Meg (49 ms) ..	549.
Hardcard 40 Meg (28 ms) ..	699.
Passport (20 or 40 Meg removable drives) ..	call

Seagate ... 1 year

FREE PCTV® Hard Drive Installation Tape with the purchase of 20, 30 or 40 Meg Seagate drive for the IBM PC (not for AT). Specify Beta or VHS.

20 Meg Internal Hard Drive ST225

(w/controller and cables, 65 ms) ..	299.
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30 Meg Internal Hard Drive ST338

(w/controller and cables, 65 ms) ..	329.
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40 Meg Internal HD ST251 for AT (40 ms) ..

40 Meg Internal HD ST251 for XT ..	399.
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(w/controller and cables, 40 ms) ..

40 Meg Internal HD ST251-1 for AT ..	449.
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(28 ms) ..

40 Meg Internal HD ST4096 for AT ..	449.
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(28 ms) ..

60 Meg Internal HD ST4096 for AT ..	669.
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TEAC ... 1 year

AT 360k Drive (5 1/4" half-height) ..	89.
---------------------------------------	-----

720k Drive (3 1/2" half-height, specify XT or AT) ..

1.44 Meg Drive for AT (3 1/2" half-height, includes Bastech software utilities) ..	95.
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1.44 Meg Drive for AT (3 1/2" half-height, includes Bastech software utilities) ..

119.	
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Toshiba ... 1 year

AT 360k Drive (5 1/4" half-height) ..	89.
---------------------------------------	-----

AT 1 2 Meg Drive (5 1/4" half-height) ..

99.	
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AT 1 44 Meg Drive (3 1/2" half-height, includes Bastech software utilities) ..

119.	
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DISKS

All disks have a lifetime warranty

5 1/4" DS/DD Disks for PC & XT (360k)	
Fuji MD2D (10 disks per box) ..	12.
Sony (10 disks per box) ..	12.
Maxell MD2-D (10 disks per box) ..	13.
Verbatim Datafile (10 disks per box) ..	13.

5 1/4" DS/High Density Disks for AT (1.2 Meg)

Fuji MD2HD (10 disks per box) ..	\$22.
Sony (10 disks per box) ..	23.
Maxell MD2-HD (10 disks per box) ..	23.
Verbatim Datafile (10 disks per box) ..	22.

3 1/2" DS/DD Diskettes (720k)

Sony (10 disks per box) ..	19.
Fuji (10 disks per box) ..	19.
Maxell (10 disks per box) ..	20.
3 1/2" DS/High-Density Diskettes (1.44 Meg)	
Sony (10 disks per box) ..	55.
Fuji (10 disks per box) ..	55.
Maxell (10 disks per box) ..	59.

MISCELLANEOUS

CompuServe

CompuServe Information Service ..	24.
Grolier's Online Encyclopedia ..	19.

Cables ... lifetime

Smartmodem-to-AT cable (9 feet) ..	15.
Parallel Printer cable (15 feet) ..	19.

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- We accept VISA and MASTERCARD only
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- No sales tax
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- Allow 1 week for personal and company checks to clear
- C.O.D. max. \$1000. Cash, cashier's check, or money order
- 120 day limited warranty on all products *
- To order, call us Monday through Friday 9:00 to 9:00, or Saturday 9:00 to 5:30. You can call our business offices at 603/446-3383 Monday through Friday 9:00 to 5:30.

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- For monitors, printers, Bernoulli Boxes, computers, and hard drives, pay actual charges. Call for UPS 2nd Day & Next Day Air
- For all other items, add \$3 per order to cover UPS Shipping. For such items, we automatically use UPS 2nd Day Air at no extra charge if you are more than 2 days from us by UPS ground
- Hawaii:
- For monitors, printers, Bernoulli Boxes, and computers, actual UPS Blue charge will be added. For all other items, add \$3 per order
- Alaska and outside Continental US:
- Call 603/446-3383 for information

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PC Carnival.

Revel without a Claus.

In the festive town of Marlow, NH (pop. 557), the holiday spirit lasts long after Santa's packed it in for the year. In fact our sure-pawed mascots are already preparing for their annual Winter Carnival – a seasonal celebration featuring skating, sledding, sleigh rides and ice sculpture. This annual event certainly provides a welcome break from our usual winter sports, e.g. thawing frozen pipes, jump starting cars, putting out chimney fires, and skidding off the road into ten foot snow drifts.

Breaking the mold.

(Or, where's the P word?)

Our more loyal and linguistically-inclined customers may have noticed that we've abandoned the "P" words in our headlines in favor of the "C" words. Because after five years of parading a profusion of P patter past PC pros on periodical pages, we perceived that perhaps they paled next to the possibilities and potential

of creative constructions consisting of C words. 'Nough said. Rest assured, though, our letter-perfect mascots still stand (and occasionally sit, roll over, and do handstands) for everything true and noble in the microcomputer mail order marketplace. If you're looking for a single source for superior savings, sensational tech support, and specially speedy shipping, we're definitely your Connection.

The ice mammal cometh.

Wouldn't you like to wake up every morning to a vision of microcomputing's most magnificent mammal? Well, now you can do that and quench your thirst for a taste of Marlow's winter wonderland with your very own PC Connection mug. It features a crystal-clear likeness of our oh-so-cool, but heartwarming mascot, and is free to anyone who places an order of \$500 or more between now and March 31st.

Just call 1-800/243-8088 or 1-603/446-3383, M-F 9:00 to 9:00; Saturday to 5:30. If you're planning to visit please call ahead.



Warm the cockles of your heart with a PC Connection mug featuring the mascot who never slakes on this ice. Offer not available to net accounts. One per customer.

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THE ADAPTER MAKES THE PICTURE

The on-screen quality you see on any 8514 display is controlled by the 8514/A display adapter and the standard under which it was created.

The 8514/A display adapter itself is a bulky board that fits only Micro Channel expansion slots. An elaboration on the VGA standard, it uses analog outputs and the same digital-to-analog converter as does IBM's VGA circuitry. In fact, its default mode of operation exactly mimics the VGA. It supports both monochrome and color displays and can distinguish between them using identification bits provided by the monitor through special leads in its connecting cable.

The circuitry of the 8514/A display adapter is built from conventional transistor-transistor logic, and its native endowment includes 1/2MB of memory. A full-length daughtercard that plugs into the 8514/A component-side-to-component-side doubles its RAM supply to 1 full megabyte. A plastic backing on the daughtercard prevents the thick, two-card sandwich from shorting itself against other boards in adjoining Micro Channel slots.

In the 8514/A adapter's native 1,024-by-768 mode, its 1/2MB of memory is divided into four 1-megabit planes that allow 16 colors to be displayed on-screen simultaneously. In this configuration, 128K of the board's memory is left to spare, 256 kilobits in each of its bit-planes.

The bits assigned to the on-screen im-

age itself reside in the lowest portion of the RAM. The rest are put to work as auxiliary storage for functions such as area-filling and holding downloadable character sets.

Although all the memory on the 8514/A board can be addressed directly by the host microprocessor, IBM does not support direct writing to this auxiliary storage area. (IBM encourages the use of the Application Interface, a form of BIOS, rather than direct memory and register writing for all 8514/A operations.) Writing to this reserved area may destroy information that the 8514/A has stored there for another purpose.

The additional daughtercard memory stacks another four bit-planes into memory, allowing the 8514/A to handle 1,024-by-768-pixel images in 256 simultaneous on-screen colors drawn from a palette of 262,144. In high-resolution mode, the entire memory of the 8514/A and daughterboard is partitioned to leave an auxiliary storage area much like that of the unenhanced 8514/A. The only difference is greater color depth.

In its VGA-compatible mode, the 8514/A divides up its basic 1/2MB into eight 1,024-by-512 bit-planes arranged in two independent banks four bit-planes deep for 16-color operation. Again, an area corresponding to 640 by 480 on-screen pixels is used for main video stor-

age, with the balance of RAM reserved for auxiliary purposes.

The hardware design of the 8514/A does not allow combining these planes into one 8-bit plane to achieve 256 colors when the board is not enhanced by its daughtercard. However, adding the memory expansion daughtercard allows both of its independent banks the full 8-bit, 256-color range of the VGA standard.

A GREATER BANDWIDTH Getting the information for all those pixels to the screen requires a much greater bandwidth than that used by the standard PS/2 VGA system; the 8514 bandwidth is 44.90 MHz as opposed to VGA's 25.17 MHz. Actually, if the system weren't interlaced, the required bandwidth for the high-resolution signals from the 8514/A adapter would have to be at least 20 percent higher to avoid flicker. Interlacing permits the 8514/A display adapter to use a relatively low vertical scanning frequency, or frame rate of 43.48 Hz (versus 60 or 70 Hz for VGA modes). Interlacing doubles the frame rate, thereby giving an 86.96-Hz scanning rate for each of the two separate fields that make up a single frame.

Because of the low frame rate, the horizontal scanning frequency of the 8514/A system in its high-resolution

without demonstrating this problem, indicating that its origin is electronic rather than an aspect of the mechanical construction of the display.

A push button to activate the degaussing circuitry and a fuse holder are also available on the rear panel. The requisite brightness and contrast controls are thumbwheels hanging beneath the right side of the front panel bezel. The power switch is a push button that's molded into the rim of the bezel, and a green LED pow-

er indicator is located nearby. The medium gray screen of the ECM-1910 is antiglare treated.

SHARP AND COLORFUL The colors and sharpness of the display proved good, notwithstanding the 720-line maximum resolution claimed in the manual. The display tube itself with its 0.31-mm dot pitch is more than capable of the resolution demanded by 8514/A, although the 30-MHz bandwidth of the ECM-1910 electronics

does not seem up to the requirements of the 8514 standard.

The image aspect ratio depends on the settings of the height and width controls. Throughout their ranges, image geometry appeared very good—straight lines stayed straight. Alignment failed in the screen corners, possibly due to the deterioration of the upper lines of the image.

For applications requiring multiscan capabilities, the ECM-1910 is a good, workable display. For use under the 8514

mode does not have to be increased dramatically in order to fit 60 percent more pixels on each line (1,024 versus the 640 used by VGA). The 8514/A increases the horizontal scanning frequency of the VGA system from 31.47 kHz to a relatively modest 35.52 kHz.

The 8514/A operates independently of the VGA circuitry built into its computer host. When software changes the memory of the VGA, it does not necessarily change that of the 8514/A and vice versa.

When the 8514/A is in its VGA mode, the two VGA systems duplicate one another, which means that a system that has an 8514/A and matching monitor can boot up with a normal VGA image on its screen.

Not all software operations affect the VGA and 8514/A identically, however. For instance, if you're using both an 8514 and a VGA display, loading a palette or changing modes may put incorrect colors or a skewed gray scale on one of the displays (usually the 8514 connected to the 8514/A).

When the 8514/A operates in its native, high-resolution mode, its screen and that of the VGA system can be used independently. Typically, your software might put text displays on the VGA screen while the 8514/A draws images.—Winn L. Rosch

standard, however, it ranks as less-than-desirable because of its lack of autosizing abilities.

IBM CORP.

IBM 8514 Color Display

The top of IBM's lineup of PS/2 displays is the \$1,550 Model 8514, the largest (with a 16-inch tube) and highest resolution color monitor that IBM offers for personal computers.



The standard that other monitors mimic, the \$1,550 IBM 8514 Color Display is the top of IBM's lineup of PS/2 displays. It is the largest and highest-resolution color monitor that IBM offers for personal computers. It features but three controls: a rocker switch and brightness and contrast thumbwheels.

As dean of the display line, the 14¼- by 15¼- by 16¼-inch case of the 8514 matches the styling of the smaller IBM monitors and is finished in the same white-beige that coats the other PS/2 products. A darker gray bezel about 1½ inches wide surrounds the screen. This bezel is inset slightly from an ¼-inch rim that runs around the set.

The corners of the case are squared off with a 4½-inch deep rectangle extending back from the front of the set, then tapering to a smaller cross section surrounding the neck of the display tube. A built-in tilt-swivel stand lifts the 8514 about 2 inches above the work surface or system unit the

display rests upon. Although finished almost entirely in plastic, the 8514 is certified up to the Class B FCC standard.

TRUE TO THE STANDARD By definition, the 8514 is compatible with the 8514 standard. Only analog inputs are available, and the range of scanning frequencies handled by the display is limited to those used by official IBM display standards. The 8514 recognizes two horizontal synchronizing frequencies, the 31.47 kHz of the VGA standard and the 35.52 kHz of the 8514/A display adapter. It also operates with three vertical scanning frequencies—60, 70, and interlaced 43.48 Hz.

■ 8514 MONITORS

For connecting with PS/2s and the 8514/A board, the 8514 display provides a 70-inch-long nondetachable video cable that terminates in a male 15-pin, high-density D-shell connector. The power cord is removable. Both cables extend from the lower rear of the set.

In keeping with the current minimalist trend, the 8514 has but three controls—a rocker switch on the top-right edge of the case behind the front panel and brightness and contrast thumbwheels on the left side. None of the more exotic controls, such as size or position, are available, but the on-screen image presented by the 8514 evaluation system made them superfluous.

PERFECT ASPECT RATIO Only about 15 inches of the display tube is visible inside the bezel, and the active image extends across 13 inches of it. As you would expect from an IBM display, its aspect ratio measured a perfect 1.33 and the



FACT FILE

IBM 8514 Color Display
IBM Corp.

Contact your nearest authorized IBM dealer.

(800) IBM-2468

List Price: \$1,550

Requires: 8514/A display adapter.

In Short: The largest (16 inches) and highest resolution monitor IBM offers, the 8514 recognizes two horizontal and three vertical scanning frequencies and has perfect aspect ratio. Its hassle-free design makes for minimal user intervention.

CIRCLE 895 ON READER SERVICE CARD

screen geometry was as good as any monitor can offer. All lines were rendered straight, no matter how near they ran to the edge of the display area.

The automatic image sizing derived

through the polarity of the synchronizing signals worked as it was designed to. The images displayed in all modes matched one another in size. The image was as large as it could be on the screen and correctly centered.

The image itself is bright and colorful against the medium black background of the tube face. Antiglare treatment of the screen face helps increase overall contrast. The image was adequately sharp, in part due to the 0.31-mm dot-pitch of the display tube. Convergence proved less than perfect and was the limiting factor in overall resolution of the 8514, however, with the red gun off by up to 0.5 mm in some corners of the display.

The greatest strength of the 8514 is its hassle-free design, requiring minimal user intervention. You can plug it in and rest secure that it will work perfectly with an 8514/A board. On the other hand, although the 8514 defines its own display

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■ 8514 MONITORS

standard, it is also limited by it. It cannot transcend the 1,024- by 768-pixel interlaced resolution of the 8514 standard or work with other display standards, as can multiscan monitors. Nevertheless, the 8514 is undoubtedly the best display offered by IBM.

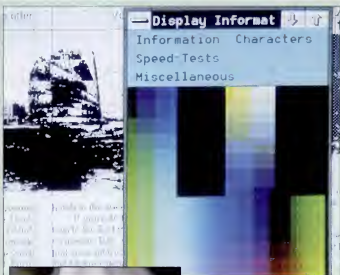
MICROVITEC INC.

Microvitec 1019/SP

As big-screen, high-resolution displays go, the Microvitec 1019/SP is odd-looking: a gray beige front panel that extends squarely back in pale beige to meet a matching multiangle metal box. Aesthetics aside, the design of the \$2,395 unit shows inspiration—all of its manual adjustment controls are located on a recessed control panel tucked just below the lower-right corner of the screen. A tilt-swivel stand is included with the 1019/SP but it must be installed by the user.

Despite the metal in the 17½- by 18½- by 19½-inch (HWD) cabinet, the English-made 1019/SP earns only a business class FCC Class A certification. One reason for this is that the monitor may be called upon to deal with some pretty exotic signals. The multiscan display boasts a 40-MHz bandwidth and maximum on-screen resolution of 1,365 by 886 pixels. It handles signals with vertical scanning frequencies from 45 to 100 Hz and horizontal scanning frequencies from 15 to 36 kHz.

Separate digital and analog inputs are available on the rear panel, both using 9-



The \$2,395 Microvitec 1019/SP is somewhat odd-looking, but it's well designed; all of its manual adjustment controls are located on a recessed control panel. It earns high marks for the high-quality images it produces and for its price, which is hundreds of dollars less than similar-size displays.



FACT FILE

Microvitec 1019/SP

Microvitec Inc.
1943 Providence Ct.
College Park, GA 30337
(404) 991-2246

List Price: \$2,395; anti-glare shield, \$129;
CVGA-10 cable, \$34.95.

Requires: Any 8514/A, VGA or EGA display adapter or compatible.

In Short: An inexpensive 19-inch color display with multiscan analog and digital inputs. Includes tilt-swivel base. A version with long-persistence phosphors is available as the 1019/W.P.

CIRCLE 884 ON READER SERVICE CARD

pin D-shell sockets. A front-panel rotary switch selects whether digital or analog (or one of two auxiliary) inputs is active. Microvitec supplies a 60-inch adapter cable to connect with the 15-pin high-density VGA-8514/A standard.

Besides the selector switch, the front panel controls of the 1019/SP include brightness, contrast, horizontal and vertical size and position controls, a slide switch for color mode when the display is operating with its digital interface, and a push button to activate the degaussing circuitry. Inexplicably, however, the most

often-used control—a rocker switch that controls the input power—is banished to the rear panel.

THE WEEP-WOW EFFECT The size controls have sufficient range to stretch the image beyond the 19-inch (diagonal) bounds of the screen bezel, and the position controls move the image without running into any on-screen barriers. The monitor automatically adjusts the picture height to the number of lines in the input signal, although it takes a couple of seconds to settle down when changing stan-

LOW-COST, HIGH-RES ALTERNATIVES TO 8514

Proprietary monochrome display systems offer higher resolution at lower prices than do 8514-compatible monitors.

An 8514-compatible display will give you CAD-quality resolution at a relatively low cost, but it's not the only show in town. High-resolution monochrome displays can deliver on-screen images as good as or better than 8514-compatible monitors at temptingly low prices can. The least-expensive monochrome systems, comprising both display and adapter, cost about the same as either an IBM 8514/A adapter or the cheapest 8514-compatible color display. Moreover, unlike IBM's 8514/A display adapter, most of these proprietary monochrome systems are compatible with the classic PC-bus rather than with the Micro Channel, making them more immediately useful to PC users.

The low cost of monochrome systems, even those with superior resolution, is a result of single-color displays being less complex than multicolor displays. Instead of the three guns found in most color sets, monochrome displays require but a single electron gun and no shadow masks. Because no multiple guns need be converged or aligned, monochrome monitors also need fewer adjustments and suffer fewer setup problems. Their simpler electronics fit into smaller, more-elegant packages and consume less power.

The lowest-cost monochrome alternatives to an 8514 video system are the Amdek Monitor/1280 and the Wyse WY-700, 15-inch paper-white displays that could be considered twins under their skin. Each will deliver a resolution of up to 1,280 by 800 pixels as well as

full CGA and MDA emulation for \$999, including a proprietary display adapter.

Besides the 14-inch, 8514-compatible monochrome Max-15 display, Princeton Graphic Systems offers two proprietary models; each costs \$1,500. Labeled the LM-300 and LM-301, the former operates in portrait orientation (the long axis of the screen is vertical); the latter, in landscape mode. Either will put 1,664 pixels across the long axis of its 15-inch tube and 1,200 pixels across the short axis. The LM-300 promises no IBM emulations through its proprietary LaserPage interface, but the PG-1600 interface of the LM-301 will put both CGA and MDA images on-screen.

The 16-inch square NEC MonoGraph delivers a 1,024- by 1,024-pixel image using its own MonoGraph System Board display adapter. The \$1,995 system will also emulate an IBM CGA video system.

Taxan's \$2,195 Crystal View system is the lowest-cost big-screen (19-inch) monochrome system that delivers greater-than-8514 resolution. In addition to the 1,280-by-960 pixel images delivered through its proprietary TX-1280 controller, double-scanned CGA images can also be generated.

Matching the 8514's resolution (1,024 by 768) but not compatible with the Application Interface of the 8514/A, Thomson's \$2,290 980W is a 20-inch display that's also compatible with CGA, MDA, and Hercules images using its proprietary Thomson AGC adapter.

The Cornerstone Vista 1600 will deliver supersharp 1,600-by-1,280 images

on its 19-inch screen using its Vista 1600 Custom Controller. The \$2,395 system also emulates a Hercules monochrome graphics board.

Monitem offers a series of big-screen, high-resolution monochrome displays. The most popular is the \$2,395 Viking 1 system that uses a 19-inch landscape display; 24-inch and portrait models are also available. In its proprietary mode, the Viking 1 controller will create images as sharp as 1,280 by 960 pixels, although it is also compatible with the CGA, MDA, and Hercules graphics video standards.

For the same price, the Sigma LaserView Plus puts more pixels—a 1,664-by-1,200 array—on a screen of the same size as the Viking 1's. Its LaserView Plus display adapter is also Hercules graphics compatible.

Conographic's ConoVision 2800 is a \$2,620 portrait-oriented display with a 19-inch screen. Using its proprietary CV-2800 display adapter, it paints a 720-by-2,880-pixel image on the screen and is also Hercules compatible.

Control Systems offers a monochrome monitor and display adapter package with 1,024 by 768 non-interlaced resolution on a 19-inch screen as its \$2,795 Artist Monochrome System 64. You can also bundle the company's \$1,995 Artscreen 19/160/M 19-inch monochrome monitor and Artist Designer 16 video controller (\$2,795 with two MB of RAM, \$3,995 with 4MB) to display 1,664-by-1,200-pixel noninterlaced images. —Winn L. Rosch

dards. There's a slight "weep-wow" effect—the image expands and shrinks as it settles down.

The 1019/SP's on-screen color and saturation proved very good, aided by the dark black matrix and antireflect treatment of the picture tube. The quality should be

even better with a new, superfine etched tube that became standard shortly after this evaluation was completed.

Image geometry also proved very good. All straight lines were straight whether they ran vertically, horizontally, near an edge, or near the center of the

screen. Alignment was also good. Aspect ratio depends, of course, on the adjustment of the size controls.

The 1019/SP did demonstrate an electronic problem—a distinct overshoot on input square waveforms, such as a sharp edge between two edges of different col-

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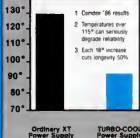


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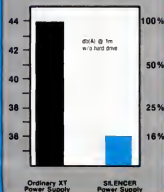
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■ 8514 MONITORS

ors. A thin, bright line defined the left, vertical edge of all such high contrast areas. It's a small problem that most people may never notice, but one that should not exist.

The 1019/SP earns high marks for its very good image and a price that's hundreds of dollars lower than similar-size displays. If its minor image problems don't bother you, it can be a best buy.

MITSUBISHI ELECTRONICS AMERICA INC.

Mitsubishi FA3425L9

Although Mitsubishi's not-too-cleverly named FA3425L9 is a little display, the \$1,175 monitor features a big difference. This Japanese-made set is the only 8514/A-compatible display that takes the 8514 standard to heart, with its long-persistence phosphors that eliminate the last trace of flicker from interlaced images.

The Mitsubishi's 14-inch tube is masked down to 13 inches by a bezel that matches the rest of its plastic case in contour and color. Standing just 12 by 13 1/4 by 14 1/4 inches on its own flat feet (a tilt-swivel base is optional) the FA3425L9 is streamlined like a '50s spaceship, all curves and contours, but RFI-protected up to the FCC Class B certification level.

Auto-tracking and multisynchronizing capabilities make the FA3425L9 compatible with just about any display standard currently used by personal computers—not just CGA, EGA, PGC, VGA,



The only 8514/A-compatible featuring long-persistence phosphors, which eliminate the last trace of flicker from interlaced images, the \$1,175 Mitsubishi FA3425L9 is compatible with just about every display standard currently used by personal computers.



PC FACT FILE

Mitsubishi FA3425L9

Mitsubishi Electronics America Inc.
991 Knox St.
Torrance, CA 90502
(213) 217-5732

List Price: \$1,175 (with long-persistence phosphors); \$1,015 (with short-persistence phosphors); FA-5 interface cable, \$45; tilt-and-swivel base, \$30.

Requires: Any VGA or 8514/A display adapter

In Short: A multiscan display that delivers a 12 1/2-inch image with any IBM graphics standard and that puts all of its vital controls up front.

CIRCLE 693 ON READER SERVICE CARD

and 8514/A, but also Hercules monochrome and color, Apple IIGS, and Macintosh II. It accepts vertical scanning frequencies from 50 to 87 Hz and horizontal signals ranging from 15.7 to 35.5 kHz.

Although its bandwidth is 40 MHz, the FA3425L9 claims on-screen resolution of only 800 by 560 pixels. True to the IBM standard, it reaches 8514/A quality—1,120 by 780 pixels—when interlaced.

The FA3425L9 accepts both analog and digital signals through two sets of input connectors. One high-density 15-pin D-shell serves both modes, and a set of

five BNC connectors link to separate-sync, sync-on-green, and composite-sync analog signals.

The only unfortunate design element of the FA3425L9 is its 60-inch VGA connecting cable, which has a 15-pin, high-density D-shell connector at each end but is not symmetrical. The connectors at either end are pinned differently, which would create problems if you inadvertently inverted the ends.

FULL ARRAY OF CONTROLS

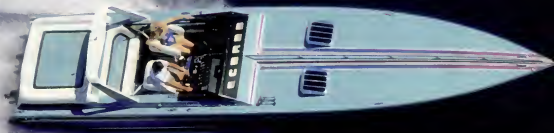
The front-panel controls of the unit are generous: contrast, brightness, horizontal

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■ 8514 MONITORS

size, horizontal position, vertical size, and vertical position are all tucked under the edge of the bezel, all thumbwheels with center detents. A push-button on/off switch and LED power indicator on the lower-right corner of the bezel complete the array.

At the rear of the monitor, Mitsubishi provides an analog/digital input selector slide switch, an overscan slide switch labeled "wide—normal," a mode slide switch (which defeats the auto-tracking that keeps images the same size under different modes), and a text-mode slide switch. You select text-mode colors such as green, amber, and white as well as the TTL color palette (8, 64, and two 16-color modes) by using a bank of four DIP switches.

The control range of the front-panel thumbwheels is unusually good, allowing the image to move beyond the bezel on any side. While the default image measures

only 11 inches diagonally, you can expand it to fill the screen vertically, but it falls about 1 inch short of spanning its entire width when not in overscan mode.

With the front-panel controls set at their defaults, the aspect ratio of the FA3425L9 looks a bit short (1.28 versus 1.33) but the image geometry proved excellent, alignment was good, and the sharpness of the 0.28-mm dot-pitch screen also proved to be good. Colors on the dark tinted and anti-glare-coated screen were uniformly bright and saturated.

Until you get used to them, the long persistence phosphors of the FA3425L9 may prove bothersome. Image lag is substantial: on a par with the original IBM monochrome display. Although you may not like the ghostlike effect on quick text scrolls, on CAD drawings (which don't scroll or change dramatically) it should not be objectionable.

In fact, the absolute lack of flicker may

be the best recommendation of the FA3425L9. But, if you still can't tolerate the light lag, you might try a short-persistence version of the display, which Mitsubishi offers as the FA3415, priced at \$1,015.

NEC HOME ELECTRONICS (USA) INC.

NEC MultiSync XL

The world owes the seeming catchall name MultiSync to NEC, whose trademark it remains. The biggest monitor to wear that label is the MultiSync XL, a hulking display equipped with a 20-inch tube and a case that stands 18½ by 19 by 21¼ inches (HWD) on its built-in tilt-swivel stand. The \$3,199 Japanese-made display earned only a Class A FCC certification.

Carrying on the MultiSync tradition, the XL automatically adjusts its circuits to adapt to whatever synchronizing frequen-

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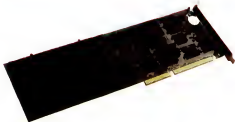
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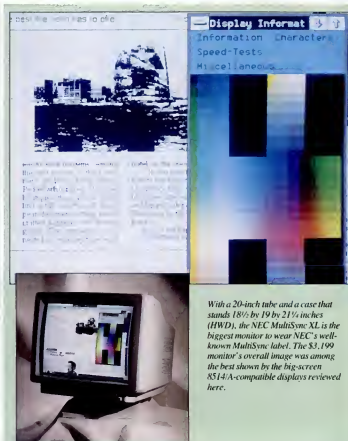
■ 8514 MONITORS

cies are presented to it. Its range is truncated on the low end and does not stoop back to the CGA standard. It can accommodate EGA, VGA, PGC, and 8514/A video signals, however. Acceptable vertical scanning frequencies range from 56 to 80 Hz, horizontal from 21.8 to 50 kHz. Maximum resolution is 1,024 by 768 pixels.

ANALOG AND DIGITAL INPUTS The XL handles both analog and digital inputs through two sets of connectors on its back panel. Normally, you'll want to use the 9-pin D-shell socket that accommodates both analog and digital signals; you select the operating mode by flipping a slide switch located above it. Analog signals can also use a set of four BNC connectors that accept both separated-sync and sync-on-green RGB signals. One important operational difference distinguishes the input connectors—while the 9-pin is good only for a 30-MHz bandwidth, the BNC connectors allow a bandwidth up to 65 MHz.

Two input cables are supplied with the XL. One terminates in a 9-pin D-shell for EGA and PGC display adapters. The other ends with a 15-pin high-density D-shell for use with VGA and 8514/A systems.

Other controls on the rear panel include an 8/16/64 selector switch for color mode compatibility with non-IBM computers, a manual switch that defeats automatic image sizing for the various IBM video standards, and an input level switch that allows for nominal analog inputs of 0.7 or 1.0



With a 20-inch tube and a case that stands 18½ by 19 by 21½ inches (HWD), the NEC MultiSync XL is the biggest monitor to wear NEC's well-known MultiSync label. The \$3,199 monitor's overall image was among the best shown by the big-screen 8514/A-compatible displays reviewed here.



FACT FILE

NEC MultiSync XL

NEC Home Electronics (USA) Inc.
1255 Michael Dr.
Wood Dale, IL 60191-1094
(312) 860-9550

List Price: \$3,199; 8514/A cable adapter, \$19.95.

Requires: Any MCGA, EGA, VGA, PGC, SuperVGA, Macintosh II, or 8514/A display adapter.

In Short: The classic NEC MultiSync display grown up to a 19-inch image, the MultiSync XL accepts a wide range of scanning frequencies through TTL and analog inputs and includes a tilt-swivel base.

CIRCLE 692 ON READER SERVICE CARD

volts. Brightness and contrast thumbwheels are tucked under the right-front edge of the display; behind them is a push button to activate the built-in degausser. A push button that controls input power is under the lower-right corner of the screen.

Image position and size controls (both horizontal and vertical) are hidden behind a door under the left side of the screen. These can help compensate for the somewhat small 16½-inch image presented across the 19-inch visible screen (the default with the size controls set at the detent in the middle of their rotation). The range of the position controls is scant, however.

For example, the horizontal control ends its rotation while the active image is still ½ inch from the bezel on the screen.

Additional controls on the rear panel include two slide switches that operate only with digital input signals for text mode. One toggles text mode on and off; the other sets the text color as amber, green, or white. A selector that chooses either the BNC or D-shell input connector is also located here.

HIGH ASPECT RATIO With the size controls set at their detents, the aspect ratio of the XL measured slightly high, but not

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■ 8514 MONITORS

objectionably so (about 1.40 versus 1.33). Image geometry was correct, and alignment proved very good with the green gun slightly high at the top of the image but within the 0.7-millimeter rating of the set.

Image quality was very good on the 0.31-mm dot-pitch tube, as were color and contrast. The screen background is dark gray and its face is coated to reduce glare.

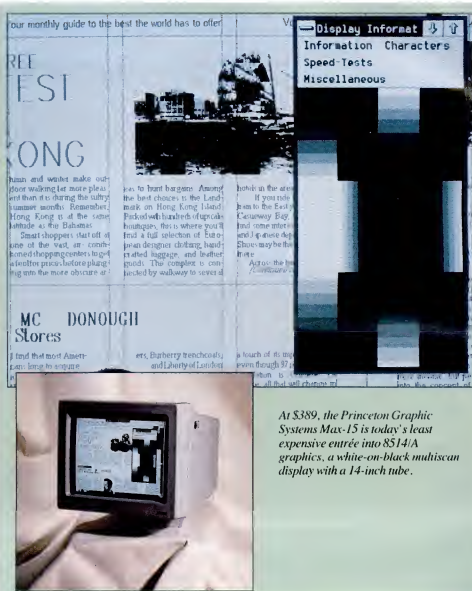
Although somewhat small, the overall XL image was among the best shown by the big-screen 8514/A-compatible displays reviewed here. Its biggest drawback is its stiff price.

PRINCETON GRAPHIC SYSTEMS

Princeton Graphic Systems Max-15 Princeton Graphic Systems Ultra 16

If you don't need color or you do need the dollars that a color 8514-compatible display would cost, put your mind on a single track and think monochrome. For \$389 you can have today's cheapest entrée into 8514/A graphics, Princeton Graphic Systems' Max-15, a white-on-black multiscan display with a 14-inch tube. If price isn't a factor, about \$1,000 more will buy you the Ultra 16, Princeton Graphic's 16-inch color 8514-compatible display.

The Max-15 accepts both analog and digital inputs through its 25-pin D-shell socket; the interface is chosen by the adapter cable that you use. Princeton sup-



At \$389, the Princeton Graphic Systems Max-15 is today's least expensive entrée into 8514/A graphics, a white-on-black multiscan display with a 14-inch tube.



FACT FILE

Princeton Graphic Systems Max-15

Princeton Graphic Systems
601 Ewing St., Bldg. A
Princeton, NJ 08540
(609) 683-1660

List Price: \$389 (including cable).

Requires: MDA, Hercules, CGA, EGA, PCG, VGA, or 8514/A display adapter or compatible.

In Short: The Max-15 is a 14-inch monochrome display with an antiglare etched flat screen and built-in tilt-swivel base that's compatible with all IBM video standards.

CIRCLE 690 ON READER SERVICE CARD

plied a 72-inch cable that terminated in a male high-density 15-pin D-shell to match VGA and 8514/A standards. A similar cable terminating in a 9-pin D-shell connects to digital display adapters. The Max-15 will handle all IBM digital video standards, including CGA, EGA, and TTL monochrome signals (which includes Hercules graphics) as well as Macintosh II, Macintosh SE, and composite video. The Taiwan-made Max-15 bears a Class A FCC certification.

ADVANTAGES OF MONOCHROME

Monochrome brings a host of advantages, not the least of which is the smaller size of

the unit. The 12½- by 12½- by 13-inch (HWD) Max-15 is light and compact enough—even with its built-in tilt-swivel base—that you don't have to worry about your PS/2 Model 50 or 70 being crushed to rubble underneath it.

The white beige plastic case and thin brownish bezel mask the display tube down to a visible 12¼ inches, while the actual active video area measures only 10½ inches diagonally, at least in 400-line normal text mode. Switch to 8514/A, and the image grows a full 2 inches vertically.

You can control the size and shape of the image with horizontal and vertical size and position controls, which are provided

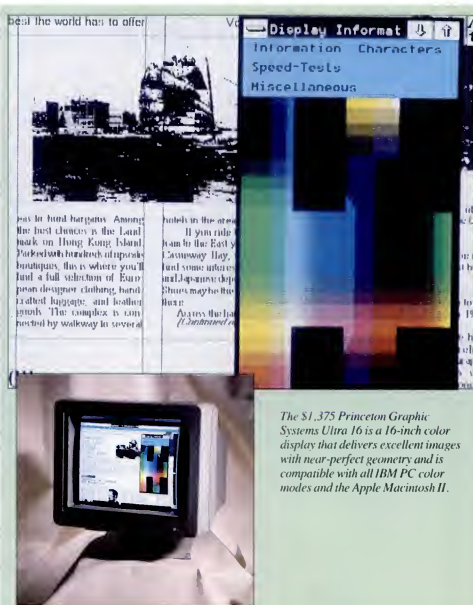
on the rear of the display. With the exception of the horizontal size control, all of these are shaft-like. There is also an under- and overscan slide switch.

If you select overscan (which is principally designed for use with Apple display systems), the image will exceed the bounds of the screen. If you use underscan (IBM mode) and adjust for a full-screen image in 8514/A, your text screen will shoot through the top of the screen bezel. The horizontal-position size control does not have enough range to move the image to the left bezel except in overscan mode.


Another slide switch on the rear panel is labeled Normal/Reverse/Mono. When digital inputs are used, this toggles between normal (EGA/CGA) displays, reverse mode (in which sync polarity determines whether 16 or 64 shades of gray are displayed), and mono, which gives four shades of gray to MDA signals.

A SHARP IMAGE The Max-15's image is sharp; it's unhampered by a shadow mask, which is unnecessary in monochrome displays. Princeton rates its resolution at 1,024 by 768 pixels and its bandwidth at 45 MHz—right on for 8514 operation. The monitor's stark, paper-white image stands out distinctly thanks to the dark face of the display tube, its ant glare treatment, and the nearly flat screen.

The brightness and contrast thumbwheels on the left side of the Max-15 have adequate range to suppress background illumination in environments with wide



The \$1,375 Princeton Graphic Systems Ultra 16 is a 16-inch color display that delivers excellent images with near-perfect geometry and is compatible with all IBM PC color modes and the Apple Macintosh II.



EDITOR'S CHOICE

FACT FILE

Princeton Graphic Systems Ultra 16
 Princeton Graphic Systems
 601 Ewing St., Bldg. A
 Princeton, NJ 08540
 (609) 683-1660

List Price: \$1,375 (including cable).
Requires: MDA, Hercules, CGA, EGA, PGC, VGA or 8514/A display adapter or compatible.

In Short: The Ultra 16 is a multiscan display that accepts a wide range of scanning frequencies to produce high-resolution color images on an ant glare etched 16-inch screen. It includes a tilt-swivel base.

CIRCLE 691 ON READER SERVICE CARD

ranges of ambient brightnesses.

Only the image geometry suffers a slight barrel distortion that causes the central portions of the image to bulge out and leads to a slight downturn of the top edge. The aspect ratio of graphics depends on both mode and control settings.

Buy the Max-15 only if you want an affordable 8514 alternative. However, you'll have to accept its several shortcomings—less-than-perfect geometry, poor mode handling, and inadequate control range. The Max-15 is a workable solution, but it needs further attention to detail to be a top choice except on price.

A COLORFUL ALTERNATIVE If the Princeton Graphic Systems Ultra 16 won't match your display board, no multiscan monitor will. Princeton claims that the \$1,375 Ultra 16 accepts the widest range of vertical and horizontal scanning frequencies, from 45 to 120 Hz and 15 to 37 kHz, respectively.

The Ultra 16 accepts both digital and analog signals and is compatible with all IBM PC color modes (CGA, EGA, VGA, 8514, and PGC) and the Apple Macintosh II. It prefers that the analog input have a nominal 0.6-volt signal. The 0.7 volts of the VGA system might slightly overdrive

■ 8514 MONITORS

the system, but then that's what brightness controls are for.

A push button on the rear panel selects whether the Ultra 16 uses its analog or digital inputs. To mate with whatever display adapter you have, the display uses a 25-pin D-shell connector. Separate 72-inch cables are supplied for digital and analog use as well as for use with the Mac II. Digital cables terminate in a 9-pin male D-shell; analog cables terminate in a 15-pin male high-density D-shell connector. Although a composite video input is available on the 25-pin input connector, Princeton currently does not offer an adapter cable to mate with this video standard.

The display tube of the Ultra 16 measures a generous 16 inches across with all but 14 1/4 inches of that masked by a greenish-tan bezel that contrasts with the white beige case (which also bears a hint of green). Sitting on its built-in tilt-swivel base, it looks like an ordinary monitor that

suffered a sudden growth spurt. It measures 16 1/4 by 16 1/2 by 15 1/4 inches (HWD), and it bears Class B FCC certification.

COLOR AND CONTRAST The dark, almost black matrix and antiglare etched finish of the screen delivers a high-contrast, colorful image. Only when brightness is set to its maximum does any flare visibly blur on-screen characters, possibly a result of the 0.1-volt overdrive. Sharpness is aided by the tube's 0.31-mm dot-pitch. The maximum resolution of the system is 1,024 by 768 pixels.

As delivered, the active image size measured 13 inches diagonally, giving an almost perfect 4:3 aspect ratio to the 10 1/2-by-8-inch picture. The image maintained its size no matter which video standard we fed to the display.

Both horizontal and vertical sizes of the image are variable; to alter them, you use

shaftlike controls on the rear panel of the display. These are augmented by an over-scan/underscan push button. The range of the horizontal adjustment was somewhat limited.

The maximum width of the image measures about 11 inches, insufficient to fill the screen in underscan mode. In overscan, the horizontal-size control cannot reduce the width of the image to fit on the screen. And in underscan mode, the horizontal-position control runs out of room when the image rests about 1/2-inch right of the left bezel. The range of the vertical adjustments is greater, allowing the image to more than fill the entire height of the screen.

Other controls on the rear panel include a color mode selected for TTL operation, which selects 16- or 64-color operation. A text-color push button cycles through a range of colors, depending on whether the analog or digital input is used. In digital

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■ 8514 MONITORS

mode, the selection is green on black, amber on black, and white on blue; in analog, amber on black, cyan on black, and green on black.

Once you set a text mode, the Ultra 16 remembers your color choice only as long as the display is turned on. Switch it off and back on, and it resets to normal color mode (white text on a black background).

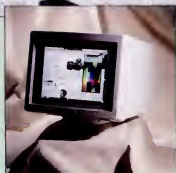
Normal display controls are hidden just under the the right-front edge of the Ultra 16. Thumbwheels are provided for contrast and brightness, and there is a rocker switch for controlling power. A long, narrow LED near the lower right of the front of the display indicates that the power is turned on.

The Ultra 16 delivered excellent images with near-perfect geometry. The color alignment of the evaluation display was also quite good, although near the corners of the display it faltered somewhat. If only control range were better and the trace of flare eliminated, it would top the list of 8514 choices.

SEIKO INSTRUMENTS USA INC.

Seiko CM-1430

Designed as a direct replacement for IBM's 8514 display, the Seiko CM-1430 mimics its operation and all of its modes in a more compact package. Measuring just 13 3/4 by 14 by 16 1/2 inches (HWD), the \$995 display is desktop and computer-top



The Seiko CM-1430 mimics the operation and all of the modes of IBM's 8514 display, in a more compact package. Measuring just 13 3/4 by 14 by 16 1/2 inches (HWD), the \$995 display is desktop and computer-top material and includes a built-in tilt-swivel stand.



FACT FILE

Seiko CM-1430

Seiko Instruments USA Inc.
PC Products Division
1144 Ringwood Ct.
San Jose, CA 95131
(408) 922-5900

List Price: \$995, including interface cable.

Requires: Any VGA or 8514/A display adapter or compatible.

In Short: An 8514 display shrunk down to computer-top size, the CM-1430 operates in all VGA and 8514 modes and yields an active display area of 13 3/4 inches. No controls are provided for altering the height, width, or position of the active image, but the factory settings are close to perfect.

Circle 600 on Reader Service Card

material, packaged in a white-beige plastic case with perforated steel bottom and meeting FCC Class B certification. A tilt-swivel stand is built in to the unit.

The CM-1430 operates at the same frequencies used by the IBM 8514. It accepts vertical scanning frequencies of 60, 70, and 87 Hz (the last interlaced) and horizontal frequencies of 31.7 and 35.52 kHz. It offers only an analog interface through a fixed 69-inch cable that terminates in an IBM-standard 15-pin, high-density D-shell connector. It supports all VGA modes (which means it emulates the CGA and EGA standards through the analog in-

terface) and full 8514/A capabilities.

As with the IBM 8514 display itself, the CM-1430 is capable of detecting sync polarity and properly adjusting the height of its displays. Moreover, it includes the proper ID signals to indicate to its host display adapter that it is an 8514 monitor.

FACTORY SETTINGS The display tube of the CM-1430 measures 14 inches diagonally and yields an active display area of 13 3/4 inches. No controls are provided for manipulating the height, width, or position of the active image. You're dependent on the factory settings, which

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Keytronic Style Keyboard, 1-360K Drive,
AT Style Case, Monographics Card w/parallel
Printer Port, Clock Card w/Serial Port,
Mono Monitor w/Swivel Tilt Base

\$709

System w/2 Drives \$787
System w/1-20 MG Drive 994
System w/1-30 MG Drive 1021

MIT SYSTEMS

PC/386

16 MHz, 1024K Memory,
200 Watt Power Supply,
Enhanced Keyboard,
1.2 MG Floppy Drive

\$1899

System w/1.2 Floppy & 40 MG Drive \$2285

Pictured Below PC/386 •



Pictured Above PC/286 Turbo •

MIT SYSTEMS

PC/286 TURBO

12 MHz, 1024K Memory,
200 Watt PWR Supply,
1.2 MG Floppy Drive,
Enhanced AT-Style Keyboard,
EGA Monitor, AT Multi I/O Card, EGA Card

\$1713

System w/1.2 Floppy & 40 MG Drive \$2097

MIT MONITORS, CARDS, MODEMS & KEYBOARDS

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Turbo PC/XT w/360K & 1 Drive & 20 MG	635	MIT I/O Serial-Parallel	38
Turbo PC/XT w/360K & 1 Drive & 30 MG	659	MIT Monographics Card	55
PC 286 12 MHz Zero Wait State w/1024K, 1.2 Floppy Drive	1190	MIT AT Multi I/O	65
PC 286 12 MHz Zero Wait State w/1024K, 1.2 Floppy Drive 40 MG	1575	MIT XT Multi I/O	65
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MIT Color Monitor	235	MIT 1200B Modem (EXT) with Software	85
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MIT Auto Switch EGA Card	139	MIT 2400B Modem (EXT) with Software	145
MIT Color Card	49	MIT Enhanced Keyboard	65
MIT VGA Card	229	MIT VGA Monitor	355

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150	309	Panasonic	
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OL2400	785	NX 1000	169
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P5200	505	Curtis	
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Ultrasync 16	839
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Max 15	239
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Mitsubishi	
Diamond Scan 14"	499
Zenith	
1490	599

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T-5100	4795
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ATI	
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Incolor	205
Intel	
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Inboard 386 AT	1025
80287-5	150
80287-6	225
80387-16	409
8087-2	140
Orchid	
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Pro Designer	299
Pro Designer +	385
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Twin Turbo	359
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Fastwrite VGA	355
VGA	265
Vega Deluxe	205
V-RAM	529

CIRCLE 123 ON READER SERVICE CARD

1-800-426-6659

■ 8514 MONITORS

are—thankfully—nearly perfect.

The 11-inch (diagonal) on-screen image of the CM-1430 does not vary at all between modes. The small screen makes the image on the 0.26-mm slot-pitch tube appear exceptionally sharp.

In testing, the image proved extremely good. Its aspect ratio was nearly perfect at about 1.30, and color alignment across the screen proved well within the manufacturer's claims. Colors were bright and saturated, rendered using normal persistence phosphors. To further enhance the image, the near-black face of the display tube is silica-coated to reduce glare.

The CM-1430 only has one user control—a brightness thumbwheel under the right-front edge of the screen. The power switch is a rocker on the rear panel, where you'll also find a fuse holder.

While the image that the Seiko CM-1430 makes is beyond reproach, a larger number of user controls would enhance the flexibility of the display. The absence of a contrast control is particularly irksome. Outside of that shortcoming, the CM-1430 is an excellent display for VGA and 8514/A applications that require only a modest viewing area.

SONY CORP. OF AMERICA

Sony CPD-1302

A venerable display, the Sony CPD-1302 has been available for more than 2 years. That this \$995 Japanese-made display can adapt to the 8514/A standard simply with the addition of a new adapter cable is a tribute to the foresight of its designers. However, 20/20 hindsight shows that they did not anticipate all of the details of the new specification, which puts the aging monitor at a disadvantage when compared with some newcomers.

The CPD-1302 has a modest screen size, about 13½ inches (diagonally), in its 11½- by 14½- by 15½-inch case. Its shape gives you the impression that someone attacked an ordinary angular monitor with a plane and sandpaper, rounded off all its edges, and curved the case to match the cylindrical curve of the Trinitron display tube. Even the finish of the FCC Class B-certified plastic case is an odd shade of battleship gray. A tilt-swivel stand is optional.

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C... make out...
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...Remember...
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...Shamans...
...with a small...
...at 2, an...
...to get...
...before plung...
...to describe a...



DONOUGH



Available for more than 2 years, the \$995 Sony CPD-1302 display can adapt to the 8514/A standard with the simple addition of a new adapter cable. But it appears that Sony did not anticipate all of the details of the new specification.

The CPD-1302 is a multiscan display, capable of handling signals with vertical scanning frequencies ranging from 50 to 100 Hz and horizontal scanning frequencies from 15 to 34 kHz. It claims maximum on-screen resolution only of 900 by 560 pixels and a maximum bandwidth of 30 MHz, but it proved capable of handling 8514/A signals without a problem.

SPECIAL CONNECTING CABLE Both analog and digital input signals connect to the single 9-pin D-shell socket recessed in the rear panel of the CPD-1302. A slide switch on the rear panel determines whether

analog or digital signal processing is used. This 9-pin connector differs in layout from nearly all others used in displays, so it requires a special connecting cable. Sony provides a 48-inch cable that terminates in a 15-pin high-density D-shell connector to hook onto an 8514/A display adapter.

Front-panel controls include the requisite brightness and contrast thumbwheels on the right side of the display, and just below them a rocker switch for power. A door on the rear panel hides the digital/analog input selector, a digital color-mode selector (CGA or EGA), and horizontal and

vertical shift (positioning) controls. No size-adjusters are available.

The CPD-1302 yields an image that measures about 12 inches diagonally in 400-line VGA modes (CGA-compatible and text). The CPD-1302 does not properly adjust the height of the image to suit the incoming video, which results in odd aspect ratios under some video standards. The 8514/A image, for instance, was more than 1 inch shorter than the VGA text-mode image. Switching modes created so much relay chatter inside the CPD-1302 that we began to suspect that there was a mouse shivering on a block of ice inside the unit.

The image-positioning controls also proved somewhat problematic. Horizontal shift, for instance, moved the image beyond the edge of the screen on the right but no closer than 1/2-inch from the left edge of the screen.

The fine, 0.26-mm slot-pitch of the Trinitron display tube produced very sharp images with delightful color, aided by the dark, antiglare-treated screen. Color alignment was slightly off but acceptable. The evaluation unit's screen geometry was far enough afield to be unacceptable, however, with verticals on the left side of the screen taking a noticeable inward bend.

Overall, the CPD-1302 is showing its age. More than an adapter cable is needed to bring it in line with the 8514/A standard.

TAXAN USA CORP.

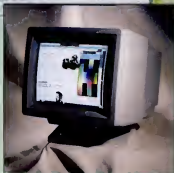
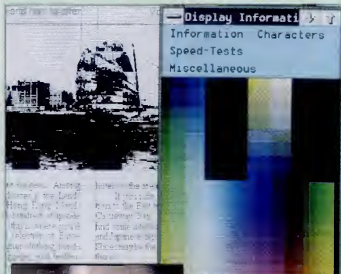
Taxan UltraVision 1000

Claiming the widest bandwidth and highest resolution of all the displays reviewed here, the Taxan UltraVision 1000 is also the most expensive, with a list price of \$3,695. Look at the image on its almost-black 19-inch screen, and you'll have to agree the UltraVision 1000 is worth its high price: it was the best performing display reviewed here.

The UltraVision 1000 accepts only analog input signals at its five BNC connectors on its rear panel (Red, Green, Blue,

Horizontal Sync, and Vertical Sync). Its circuitry can handle any vertical scanning frequency from 50 to 80 Hz, and horizontal scanning frequencies in three continuous but noncontiguous ranges: 30 to 34 kHz, 48 to 52 kHz, and 62 to 72 kHz. Taxan notes that the UltraVision 1000 will actually operate with horizontal frequencies as high as 78 kHz, but with some image degradation. In addition, the monitor had no problem handling 8514/A signals at 44 kHz.

According to Taxan, the rated bandwidth of the display is an amazing 200 MHz. On-screen resolution of the UltraVi-



Taxan's 19-inch UltraVision 1000 is the most expensive—as well as the best-performing—display monitor we reviewed, with a list price of \$3,695. Its colors shine brightly, and the sharpness of its image is beyond reproach.



FACT FILE

Sony CPD-1302

Sony Corp. of America
Computer Peripheral Products Division
Sony Dr.
Park Ridge, NJ 07656
(201) 930-1000

(800) 222-SONY (general information)

List Price: \$995; 8514/A interface cable, \$25.95; all other interface cables, \$19.95

Requires: MDA, CGA, EGA, VGA, extended VGA, PGX, Macintosh II, or 8514/A display adapter.

In Short: A vintage (2-year-old) multiscan display with a 13-inch (diagonal) image. Uses a super-fine pitch Trinitron tube to display in any IBM video standard. Includes a tilt-swivel base.

CIRCLE 100 ON READER SERVICE CARD

■ 8514 MONITORS

sion 1000 extends beyond the 8514/A standard to 1,600 x 1,200 pixels.

The UltraVision 1000 accepts the three most popular forms of discrete analog RGB signals—composite-sync, sync-on-green, and separate-sync. Normally the UltraVision 1000 is sold as a complete package with video adapter and cable. For 8514/A use, it is available separately with an optional \$45 high-density, 15-pin D-shell-to-BNC cable that is 36 inches long.

THE BIG PICTURE The big 20-inch tube of the UltraVision 1000 fits in a good-looking white-beige plastic case that seems smaller than its actual 18-by-18½-by-20½-inch (HWD) dimensions. A tilt-swivel stand is built-in. The Japanese-made package earned a Class A FCC certification.

The display's controls are tightly integrated into its overall design. The three primary user controls are in the front, recessed below the screen bezel in a narrow panel. Wide rollerlike thumbwheels on the left control brightness and contrast; a push-button power switch is also on the left side of the display. A push button to activate the built-in degasser is hidden under the set's right-front corner.

Besides the five BNC jacks, the rear panel also includes a jack for the power cord, a fuse holder, and an input voltage selector switch that allows the UltraVision 1000 to be used with 110–120 or 220–240 VAC utility power.



EDITOR'S
CHOICE

FACT FILE

Taxan UltraVision 1000

Taxan USA Corp.
161 Nortech Pkwy.
San Jose, CA 85134
(408) 946-3400

List Price: \$3,695; Model 1000-01 interface cable, \$45.

Requires: Any EGA, VGA, PS/2, or 8514/A display adapter.

In Short: A very wide bandwidth (200 MHz) 19-inch color display with very high resolution (1,600 by 1,200 pixels). Its analog-only inputs are compatible with VGA and 8514/A display adapters, and a tilt-swivel adapter is built in.

CIRCLE 667 ON READER SERVICE CARD



EDITOR'S CHOICE

- Mitsubishi FA3425L9
- Princeton Graphic Systems Ultra 16
- Taxan UltraVision 1000

We're happy to report that you're unlikely to be disappointed with any of the displays reviewed here. All of them deliver pleasing images when used with IBM's 8514/A display adapter.

You'll get the best possible picture from the Taxan UltraVision 1000. The 8514/A standard barely taps its capabilities. Its vast bandwidth and ability to match a wide range of synchronizing frequencies mean you'll be able to use it with nearly any analog video standard that might evolve in the next few years.

If price is a consideration and you want a big screen, the Microvite 1019/SP is the most affordable choice, although its minor electron-

ic problems earn it less than a whole-hearted endorsement.

Should you want a small screen that you can place atop your IBM PS/2 Model 50 or 70, our pick is the Mitsubishi FA3425L9. Its multiscan design frees you from being locked into the 8514 standard. It also gives you a reasonable range of controls and a choice of long- or short-persistence phosphors.

In the midrange—and perhaps the best general-purpose display—is the Princeton Graphic Systems Ultra 16. Its screen is large enough to show details but compact enough not to dominate a desk. Its acceptance of a wide range of synchronizing frequencies helps ensure against its obsolescence.

The more-exotic controls are hidden in a special control box that pops down from under the right edge of the set. Separate screwdriver-actuated adjustments are provided for two operating modes designated by their nominal horizontal scanning frequencies—30-kHz mode and 50/60-kHz mode. Green LEDs on the panel indicate which mode is active. The controls for the high-frequency mode include both horizontal and vertical size and position. The lower frequency mode has controls for horizontal position and vertical size.

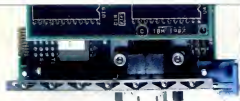
CONSISTENT AND BRIGHT Although somewhat small for the size of the display tube, the 16½-inch active image maintained consistent dimensions no matter how many lines were used to make it. The aspect ratio with the size controls set in their factory-shipped positions met the 1.33 of the IBM specification. Image geometry proved as close to perfection as possible. Even the alignment of the in-line electron guns was the best we saw on any

display, with no perceptible lack of convergence even in the corners of the image.

Colors shone brightly against the black matrix of the tube, and the contrast was heightened by an antireflection panel in front of the screen. Image sharpness was beyond reproach, thanks to the combination of wide bandwidth and the fine 0.31-mm dot pitch of the display tube.

If you want the best big screen available for operation under the 8514/A standard and you're willing to pay for it, the UltraVision 1000 is an excellent choice. In truth, however, the 8514 standard does not require all the quality this Taxan display offers. You may not notice the difference in on-screen quality between the UltraVision 1000 and a more ordinary, less-expensive display when you work only with 8514 images. But if you plan to move on to a standard with even higher resolution, this is the monitor you'll want.

Winn L. Rosch is a contributing editor of PC Magazine.



APPLYING THE STANDARD PROGRAMMING APPLICATIONS FOR 8514

The 8514/A is not the first video adapter with hardware-assisted drawing, and it's certainly not the best or the fastest. But like many other IBM products, the 8514/A provides a focal point for the industry and a potential standard on which other manufacturers can build. For this reason, it's likely that the 8514/A (including 8514/A compatibles available from other manufacturers) will be the first video adapter with hardware-assisted drawing to have widespread use on PCs.

From a programmer's perspective,



Because the video-display buffer of the 8514/A adapter card is not directly accessible by software, you'll find that programming for this card poses different challenges than does programming for such popular boards as the CGA, EGA, VGA, and the Hercules Graphics Card.

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320MB, 16ms	\$5,599	\$5,949	\$6,149
386/20 System	MGA	EGA	VGA
40MB, 28ms	\$2,849	\$3,199	\$3,399
80MB, 28ms	\$3,095	\$3,445	\$3,645
110MB, 28ms	\$3,295	\$3,645	\$3,845
320MB, 16ms	\$4,999	\$5,349	\$5,549
386/16 System	MGA	EGA	VGA
40MB, 28ms	\$2,449	\$2,799	\$2,999
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110MB, 28ms	\$2,895	\$3,245	\$3,445

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110MB, 28ms	\$2,695	\$3,045	\$3,245
320MB, 16ms	\$4,399	\$4,749	\$4,949
286/16 System	MGA	EGA	VGA
40MB, 28ms	\$2,049	\$2,399	\$2,599
80MB, 28ms	\$2,295	\$2,645	\$2,845
110MB, 28ms	\$2,495	\$2,845	\$3,045
286/12 System	MGA	EGA	VGA
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40MB, 40ms	\$1,529	\$1,879	\$2,079
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• Monitor

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• Hard Drive

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• Printer

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- Multiple type styles
- Tractor/friction paper feed

• Software

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■ 8514/A ADAPTER

the 8514/A is quite different from other popular PC video graphics boards, such as the CGA, EGA, VGA, and the Hercules Graphics Card. These earlier boards are comparatively simple. The video-display memory buffer occupies part of the normal address space of the microprocessor. To draw graphics on the display, a program writes into this memory.

The video display buffer of the 8514/A is not directly accessible from software. Instead, the board contains a hardware interface that interprets high-level graphics drawing commands. Although the hardware interface of the 8514/A is not publicly documented by IBM, the 8514/A comes with a RAM-resident program called HDI-LOAD.EXE that provides applications with a software interface to the board through interrupt 7Fh.

(Interestingly enough, *Microsoft Windows*, one of the first programs to take advantage of the 8514/A display adapter, bypasses the software interface and directly accesses the board. According to Microsoft, this was done for performance purposes.)

TECH SPECS The technical documentation for the 8514/A is contained in two IBM publications. You'll want both if you'll be doing any 8514/A programming.

The first is the *8514/A Adapter Interface Application Developer's Tutorial*. This package comprises a 52-page Programmer's Guide with a diskette that contains header files, an object module to assist C programmers in using the 8514/A interface, some sample code, a sample font file, and several utility programs. The header files provide macro definitions of 59 function calls that applications can use to draw graphics on the board.

The second publication is the *8514/A Technical Reference*, a 140-page manual that documents the 59 function calls. IBM also sells Virtual Device Interface (VDI) drivers to let you use the 8514/A with its Graphics Development Toolkit.

STRUCTURES AND FUNCTIONS To use the 8514/A from a C program you must first include the `IBMAFI.H` header file (supplied in the *8514/A Adapter Interface Application Developer's Tutorial*) in the program

```
#include <IBMAFI.H>
```

The `IBMAFI.H` file also includes another header file called `AFIDATA.H`.

The header files define macros for the 59 function calls supported by the adapter interface. Each function requires a single parameter, that is a pointer to a structure containing information specific to the function. The header files also define these structures.

For example, suppose you want to draw a filled rectangle on the 8514/A display. You first need a structure of the type `HRECT_DATA`, which you can define like this:

```
HRECT_DATA hrd ;
```

Let's assume that you want the upper-left corner of this rectangle to be 10 pixels from the left side of the screen and 20 pixels from the top, and you want the rectangle to be 30 pixels wide and 40 pixels high. You set the fields of this structure like this:

```
hrd.length = 8 ;  
hrd.coord.x.coord = 10 ;  
hrd.coord.y.coord = 20 ;  
hrd.width = 30 ;  
hrd.height = 40 ;
```

The first field of the structure is the length in bytes of the rest of the structure. The other four fields are 2-byte integers. The coordinate system supported by the 8514/A is in units of pixels with an origin at the upper-left corner of the screen.

To draw the rectangle, you pass a pointer to this structure to the `HRECT` function:

```
HRECT (&hrd) ;
```

And that's it.

FIVE GRAPHICS PRIMITIVES To get an idea of the range of 8514/A graphics, let's look at some of the basic drawing functions supported by the board and interface. The structure of the drawing commands supported by the 8514/A is very similar to the Graphics Programming Interface (GPI) component of the OS/2 Presentation Manager. Like GPI, the 8514/A supports five graphics "primitives"—lines, filled areas, markers, images, and text.

The `HLINE` and `HCLINE` functions draw polylines (connected straight lines)

based on a series of points. The `HLINE` function begins the polyline at a point specified by the structure passed to the function; the `HCLINE` function begins the polyline at the *current position*. (The current position is usually the last point used by a previous drawing function. The `HSCP` and `HQCP` functions allow a program to set or query the current position.) Although the 8514/A has no built-in facility for drawing curves, a program can define a curve as a series of very short lines and use `HLINE` or `HCLINE` to draw the curve.

Two other functions—`HRLINE` and `HCLINE`—also draw lines. The *R* in the function name stands for *relative*. With these functions, the end point of each line is an offset relative to the start point.

By default, lines are solid and 1 pixel wide. The `HSLT` function lets you select a line type (a combination of dots, short dashes, and long dashes) from eight predefined line types. You can also define your own line type with this function. Customized line types contain up to 48 bits that encode the on-and-off pattern of the line. The `HSLW` function allows you to set a line width of 1 or 3 pixels.

The second graphics primitive is a filled area. You define this area by calling `HBAR` to begin an "area bracket" and `HEAR` to end it. Between the `HBAR` and `HEAR` calls, you draw a series of lines that define the boundaries of an enclosed area. The `HEAR` function closes any open areas and fills them.

This is not a "flood fill," a type of area fill popular in many paint programs. The lines that define the enclosed area can cross each other, and you can define multiple enclosed areas within one area bracket. When the lines that define an area cross each other, the 8514/A fills the area based on an *alternate* algorithm. For example, the interior pentagon of a five-pointed star will not be filled.

By default, the area is filled with a solid pattern. However, you can use the `HSPATT` to define your own monochrome or color pattern. This pattern is a rectangle of pixels (up to 32 by 32 pixels in dimension) that is repeated horizontally and vertically within the area.

The `HRECT` function I described earlier is a special case of a filled area. The

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■ 8514/A ADAPTER

HRECT function lets the 8514/A know that you want to draw a rectangle, which the adapter hardware can fill faster than a rectangle defined within an area bracket.

The third graphics primitive is the marker. Markers are usually small symbols (like X's and circles) that are used for bullets. They can also be used to mark data items on line graphs. The HMRK function draws one or more markers beginning at a given position and HCMRK draws one or more markers starting at the current position.

The 8514/A has no built-in marker shapes. You use the HSMARK function to define your own. Like patterns, markers

**The 8514/A will likely
be used most with
environments that have a
device-independent
graphics programming
language.**

are defined by a rectangle of monochrome or color pixels. Markers can be up to 255 pixels wide and high.

The fourth kind of graphics primitive is the image, more commonly called a bitmap. The 8514/A supports several *bitblt* (bit block transfer) functions.

The HBBC function is a bitblt copy. This function copies a rectangular area from the display to another rectangular area on the display. The HCBWV function is used in conjunction with HBBCHN to write a bitmap from the program's memory to the display. The HCBBR and HBBCHN functions read a bitmap from the display to the program's memory.

The fifth and final graphics primitive is text. The 8514/A has three built-in fixed-pitch fonts. Two of these fonts are available when the 8514/A is operating in 1,024-by-768 resolution; the third is available in 640-by-480 resolution.

In addition, a program can also load its own fonts using ASFONT. These fonts would probably be stored in disk files. (*The 8514/A Adapter Interface Application Developer's Tutorial* includes a sample font file.) The program loads the font file into memory and then calls ASFONT. These fonts can have either fixed-pitch or proportionally spaced characters.

Up to four fonts can be resident in the 8514/A at any time. The HSCS function lets you select which of the four fonts you want to use in subsequent text-drawing functions.

Several functions display text on-screen. The simplest are HCHST (to display a character string starting at a given position) and HCCHST (to display the string starting at the current position). The HBLOCKCGA function displays a block of text in CGA format with alternating characters and color attribute bytes. The HBLOCKMH function is similar except that it uses a 3-byte attribute to additionally specify underlining, reverse video, strike-over, and one of the four loaded fonts.

PM AND WINDOWS Although programming graphics for the 8514/A is certainly easier than programming the EGA or VGA, it is likely that the 8514/A will be used most with environments like *Microsoft Windows* (under DOS) and the *Presentation Manager* (under OS/2).

These two environments have a device-independent graphics programming language. Programs written for *Windows* or the *Presentation Manager* can take advantage of any video adapter supported by the environment, without any special code. For example, the same programs written for *Windows* even before the 8514/A was available will run without change when *Windows* is installed for use with the 8514/A.

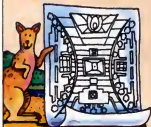
As I mentioned earlier, the structure of the 8514/A graphics interface is very similar to the Graphics Programming Interface of the *Presentation Manager*. This similarity allows the *Presentation Manager* to use the 8514/A with a minimum of fuss and makes the 8514/A the hot board for PM graphics.

Charles Petzold is a contributing editor of PC Magazine.

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Mono		\$1790	\$1899	\$2030	\$2296	\$3000	\$3923
EGA		\$2184	\$2293	\$2424	\$2690	\$3450	\$4317
VGA		\$2355	\$2464	\$2595	\$2861	\$3700	\$4488

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- 8 Slot motherboard design (6 16Bit and 2 8Bit & 2 32Bit),
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Options:

- 32/64KB Cache Processor • Weitek Coprocessor • Tower Case
- Custom configurations w/Name Brand peripherals of your choice
- Compaq® Style LCD Portable • 8MB 32Bit RAM Card

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TRACKING THE MOUSE'S PROGRESS



As the importance
and popularity of graphical
user interfaces
grow, you're going to find
that if you don't
use a mouse now,
you'll probably have to
use one soon.

Fought with the unlikely weapons of ergonomic design, bundled software, slick packaging, and aggressive advertising, today's market war for mice is best characterized as unfolding on a lucrative battleground. In the coming years, what appear to be pitched battles now may seem like mere skirmishes, for as the popularity of the graphics programs and graphical user interfaces grows, PC users' appetite for mice can only increase.

Five years ago the situation was quite different. Mouse marketers were forced to play a missionary—rather than a military—role, since mice had to compete against tablets, trackballs, touch screens, and light pens for control over a paltry number of graphics-based programs on the personal computer.

Although all of these alternate-input devices still have their devotees, the mouse is now clearly supported by the largest and widest variety of applications. This evolution can be traced to three factors: the Apple Macintosh; the rising popularity and us-

■ MICE

ability of graphics programs such as those for desktop publishing, CAD, drawing, and painting, and the fact that most graphics and graphical user interface vendors have opted to support the mouse.

Despite this growing acceptance of the mouse's usefulness, of the 32 million PCs at work today, only 7 million are equipped with mice. Richard Able, market manager for Microsoft's mouse, attributes today's low numbers to the large base of 8088 systems: "Graphics interfaces are too slow on the 8088. As buyers move to 286- and 386-based systems to run the new software, they'll find they need a mouse." IBM's official blessing of the mouse, giving it a port on the PS/2, can only make it grow more popular.

WORD OF MOUSE All of this excitement centers on a simple device that translates hand motion into cursor motion. There are four ways to make this translation:

- Most mice use a rolling ball to create and track motion. Inside these mechanical mice the ball turns two rollers at right angles—one for vertical motion, the other for horizontal. The rollers drive mechanical encoders that send signals to the PC, where software translates those signals into cursor motion.
- Optomechanical mice work on the same principle as mechanical mice, but the rollers are connected to optical encoders that use light instead of mechanical contacts to send signals.
- Wheel mice sidestep the rolling ball completely by using plastic wheels, placed at right angles, to drive the encoders directly.
- Optical mice work with a special pad containing a reflective grid of black and blue lines. As the mouse moves over the pad, photosensors inside it read the blue-and-black pattern and send that pattern to the PC to move the cursor.

Mouse mechanics don't make much difference anymore, though they once did. As a result, marketers are now trying to set themselves apart by focusing attention on mouse resolution.

A mouse's resolution is based on the sensitivity of its tracking system. Whenever the mouse detects any change in motion, it sends signals to the computer, where

they are converted into screen motion. The resolution is based on the smallest change in motion the mouse can detect and is expressed in dots per inch (dpi). A 200-dpi mouse can detect changes in motion as small as 1/200th of an inch, so for each inch that you move the mouse, the cursor moves 200 dots (pixels) on the screen. You can cover most of an EGA screen (640 by 350 pixels) in a 3- by 2-inch area with a 200-dpi-resolution mouse. Logitech's HiRez Mouse, at 320 dpi, reduces this area to 2 by 1 inches.

However, because of the 1:1 motion-sensing to pixel-movement relationship, the higher the resolution of your monitor, the more you have to move your mouse. A

■ **Dynamic tracking increases the cursor movement ratio; in a 1:5 ratio, the screen cursor moves five times as far as the mouse moves.**

200-dpi mouse needs an area 6 by 4 inches to cover a 1,200 by 800-pixel resolution monitor. That's major real estate on most desks, so mouse manufacturers developed "dynamic tracking" (sometimes called "ballistic tracking") to cover the screen in a smaller area.

Dynamic tracking lets you increase the number of pixels you move for each increment of mouse motion. Triggered by sudden mouse movements, dynamic tracking increases the cursor movement ratio, usually to a value set by the user. For example, if you select a 1:5 dynamic ratio, the screen cursor moves five times the distance the mouse moves. With a 200-dpi mouse and 1:5 dynamic tracking, 1 square inch of mouse motion covers 1,000 pixels. Mouse vendors let you change tracking ratios in different ways—some only to fixed ratio values, others to ratio values that you set using the command line or a batch file.

BUTTONS AND CASES In our last comprehensive mouse survey ("Mice for Mainstream Applications," *PC Magazine*, August 1987) 11 of the 15 mice had three buttons. This year 8 of the 17 mice reviewed have two buttons. The tide seems to be shifting; it seems that—following the *Microsoft Windows* lead—the bulk of mouse-driven applications just don't require users to make more than three choices with their mice.

The other major trend is case design. Microsoft's new mouse raised ergonomic arguments to new heights and set a standard that others try to follow. Some of the mice we reviewed look as if they were designed in wind tunnels, but in practical tests only a few shapes stood out as favorites. Case design falls into that "heart and mind" category: you're certain to develop your own preferences.

We have reviewed 17 mice marketed by 11 vendors, including Dexxa International, IBM, IMSI, Key Tronic, KYE International, Logitech, Microsoft, Mitsubishi, MSC Technologies (formerly Mouse Systems), Numonics, and Z-Nix. Microsoft remains the leader and trendsetter in the competition, with over 40 percent of total mouse sales. But Key Tronic, Logitech, and MSC Technologies are significant contenders, and new players are queuing up in noteworthy style for a share of this lucrative market.

DEXXA INTERNATIONAL Dexxa Mouse DLX

The Dexxa Mouse DLX looks like a transitional step between Logitech's older case design and Key Tronic's streamlined wedge. Dexxa's wedge-shaped case is slightly narrower than Logitech's, with two large buttons on its face. Graced with the short throw and feather touch found on the buttons of better mice, response is consistent over the entire button surface.

The 200-dot-per-inch Dexxa Mouse offers on-the-fly dynamic tracking. Set using the Ctrl-Alt hotkey sequence and a mouse button, tracking values can range from 50 to 750 dpi (in increments of 10) within most applications. As with most mice, Dexxa's tracking values cannot be changed once you're in *Microsoft Windows* because of the way the software for



The 200-dpi (base resolution) Dextra Mouse DLX comes in a case that looks like a transitional step between Logitech's older case design and Key Tronic's streamlined wedge. Dextra International's mouse offers on-the-fly dynamic tracking, and its buttons feature the feather-touch response found on better mice.



FACT FILE

Dextra Mouse DLX

Dextra International
189 Airport Blvd.
Burlingame, CA 94010
(415) 343-1688

(800) 346-4227 (end-user hot line)
(800) 343-8223 (dealer hot line)

List Price: Serial version: with *Paint-It!*, \$89; with *CCS Designer*, \$119; with both software packages, \$139. Bus version: with *Paint-It!*, \$99; with *CCS Designer*, \$129; with both software packages, \$149.

Requires: 10K RAM; 9-pin serial port (comes with optional 25-pin adapter); bus interface card included (and required) for bus version; DOS 2.0 or later.

In Short: Two feather-touch buttons and on-the-fly dynamic tracking make this 200-dpi (base resolution) optomechanical mouse a pleasure to use, even though it comes in an outdated case.

CIRCLE 666 ON READER SERVICE CARD

that operating environment is written.

Dextra Mouse tracks well in both regular and dynamic modes, and its easy button response makes it a pleasure to use in Windows. Its narrower case gives it an edge over Logitech, but in extended use the mouse still wasn't quite as comfortable as those of Microsoft or Key Tronic.

Dextra's first offering shows its Logi-

tech lineage throughout—from the way it generates menus to its case design—which is a good sign for buyers. Competitive pricing (from \$89 to \$139 for the serial version, and from \$99 to \$149 for the bus version), solid design, and above-average operation make Dextra Mouse a rookie with promise.

IBM CORP.

IBM PS/2 Mouse

Serial interface or bus? The answer was always based on the kind of system real estate you could afford to lose. Serial mice chew up one of the two main COM ports. Bus mice take up an expansion slot. IBM's answer makes the most sense and tells us volumes about where Big Blue thinks the PC industry is headed: it put a mouse port on the PS/2 and introduced the \$99 PS/2 Mouse.

The standard mouse port may catch on, but IBM's mouse is not likely to gain as wide a following as Microsoft's has. The case looks as if it has incorporated modern design features—the wide front tapers to a rounded heel, and the top surface slopes backward—but it is nowhere near as comfortable as those of Key Tronic, Microsoft, or MSC Technologies. The tapered body does not fit the hand naturally; I found myself gripping this mouse a lot and keeping my fingers raised above the surface, an al-



Designed to plug into the dedicated mouse port now standard on IBM's PS/2, the 200-dpi (base resolution) IBM PS/2 Mouse tracks respectably and operates well for routine chores. Though it looks as if it would be comfortable, the mouse's case does not fit the hand naturally and its buttons are stiff.



FACT FILE

IBM PS/2 Mouse

IBM Corp.
(Contact your IBM dealer)
(800) IBM-2468
List Price: \$99

Requires: 13K RAM, built-in pointing device port on any PS/2, DOS 3.3 or later.
In Short: A 200-dpi (base resolution) two-button mechanical mouse that's as solid as a rock and about as exciting.

CIRCLE 665 ON READER SERVICE CARD

together fatiguing experience.

The buttons wrap from the top to the face of the mouse, so I tried to keep my fingers wrapped over the buttons. This improves the feel but creates another problem: the rounded heel, tucked into your palm, causes the mouse to jump when you press a button. The buttons were stiff and lacked the feather-touch click that can be found on other mice. Double-clicking in Windows takes effort, and some practice, to master.

With practice, you may learn to ignore the flaws in this mouse's design. It does operate well for routine chores (except double-clicking) and tracks respectably in *PC Paintbrush Plus*. Still, I'm not impressed with IBM's mouse. With all the resources at the company's disposal, you might expect world-class industrial design engineering. What you get is a desk accessory that matches the PS/2 but doesn't keep up.

IMSI

IMSI OptiMouse

IMSI (International Microcomputer Software Inc.) markets the older PC Mouse from Mouse Systems under the name OptiMouse. Two years ago this three-button optical mouse represented state-of-the-art technology, but times—and users' demands along with them—have changed and IMSI is not keeping up.

Priced from \$149 to \$209, the 200-dot-per-inch OptiMouse still offers good performance. The felt-footed mouse moves easily across the pad. Button response is good, and there's a soft but audible click.



Based on technology considered state-of-the-art 2 years ago, the 200-dpi (base resolution) IMSI OptiMouse still offers good performance. It moves easily across its large pad and its button response is good, making a soft but audible click.



FACT FILE

IMSI OptiMouse

IMSI (International Microcomputer Software Inc.)

1299 4th St.
San Rafael, CA 94901
(415) 454-7101

List Price: \$149; with *Dr. Halo III*, \$189; with *Magician* or *InteGraphics*, \$239; with *TurboCAD*, \$209.

Requires: 8K RAM, RS-232C serial port, DOS 1.1 or later.

In Short: An early-model 200-dpi (base resolution) optical mouse that's known better days, though its three-button design and optical technology are current.

CIRCLE 644 ON READER SERVICE CARD

Positioning is acceptable, but the large pad forces you to move the mouse around often, and on high-resolution screens there is an excessive amount of "hopping"—pulling the mouse to one side, lifting, and starting over until you reach the edge of the screen.

Like other mice in this review, the IMSI OptiMouse is not bad, but it's not a great choice either. It lacks dynamic tracking (which it badly needs), chews up an acre on your desk, and offers nothing extra beyond the standard menu software and drivers. Unless you're attached to this design, you can do better.

KEY TRONIC CORP.

Key Tronic Professional Series Mouse

Microsoft set a standard that other manufacturers followed—some with great success, others with miserable results. Key Tronics is one of the few to develop a mouse that is equal to Microsoft's latest mouse. In some respects it's even better.

The \$119 Key Tronic Professional Series Mouse's case combines the best features of the wedge and teardrop shapes. Its two large buttons are flush-mounted and equal in size, they extend over half the length of the case. The 200-dot-per-inch mouse's left button has six tiny raised bumps on its forward surface.

Key Tronic affords complete Microsoft emulation and driver compatibility. Menu software is optional, but the package includes sample menus for *Lotus 1-2-3*, *WordPerfect*, and *dBASE III* that are worth using.

Using Key Tronic's mouse was quite enjoyable. It glides smoothly across most surfaces and feels well balanced in the hand. The buttons require only a light, sharp touch, which makes double-clicking effortless, and the response is true anywhere on the button's surface. I tend to



Housed in a case that combines the best features of the wedge and teardrop shapes, the Key Tronic Professional Series Mouse performs identically to Microsoft's in every respect. The 200-dpi (base resolution) mouse glides smoothly across most surfaces and feels well balanced in the hand. Its buttons require only a light, sharp touch, making double-clicking effortless, and the response is true anywhere on the button's surface.



EDITOR'S
CHOICE

FACT FILE

Key Tronic Professional Series Mouse

Key Tronic Corp.

P.O. Box 14687
Spokane, WA 99214

(509) 928-8000 (corporate number)
(800) 262-6006 (support outside WA)
(509) 927-5515 (support within WA)

List Price: Bus or serial version, \$119; Programmer's Tool Kit, \$27; additional 4-foot extension cord, \$7.95.

Requires: 10K RAM; RS-232C serial port (9- to 25-pin adapter comes in package for serial version); available expansion slot for bus card (which comes with bus version); DOS 2.0 or later.

In Short: The only two-button 200-dpi (base resolution) mechanical mouse that equals the Microsoft Mouse in styling and operation, with exceptional feel and good key response. Well designed, carefully documented, and an exceptional value.

CIRCLE 643 ON READER SERVICE CARD

grip my mice with a heavy hand, so I triggered the right button too easily at first. This mouse works best with a lighter touch, which shouldn't take long to acquire.

The Key Tronic Professional Series and the Microsoft Mouse perform identically in every respect. Both shapes are comfortable, both have excellent buttons, both are 200 dpi, both come in bus or serial versions. Even the menu software is optional for both. Choosing between them is hard, but Key Tronic is trying to raise the stakes: The company offers a money-back guarantee "if, for any reason, you are not completely satisfied." Strong words in this market.

KYE INTERNATIONAL INC.

Genius GM-6 Plus Genius GM-6000

KYE inexplicably offers two mice that look the same and come with the same software. Close inspection, however, reveals a few differences worth noting, and in the end the Genius GM-6000 is the clear winner in this family feud.

Both Genius mice—GM-6 Plus (\$99) and GM-6000 (\$109)—are of the mechan-



The 350-dpi (base resolution) KYE Genius GM-6000 tracks with control equal to that of the Logitech HiRez Mouse. The GM-6000's cousin, the Genius GM-6 Plus, looks identical to it (and is therefore not pictured here) but the GM-6 Plus offers only 200-dpi base resolution. Both of the KYE Genius mice come with a handy rubber mouse pad that doubles as a self-sealing cutting pad as well as a plastic "mouse pocket" that you can stick to your PC or monitor.



FACT FILE

KYE International Inc.
769 Pinefalls Ave.
Walnut, CA 91789
(714) 594-9234
(800) 456-7KYE

Genius GM-6 Plus

List Price: with Dr. Halo III, \$99.

Requires: 8K RAM, RS-232C serial interface, DOS 3.0 or later (for all current hardware shipping).

CIRCLE 662 ON READER SERVICE CARD

Genius GM-6000

List Price: with Dr. Halo III, \$109.

Requires: 8K RAM, RS-232C serial interface, DOS 3.0 or later (for all current hardware shipping, but KYE International can supply mouse driver that supports DOS 2.0 if necessary).

CIRCLE 661 ON READER SERVICE CARD

In Short: Sturdy construction and dynamic resolution are strong points, but the body style of these three-button optomechanical mice is not as comfortable as that of others. The 350-dpi (base resolution) GM-6000's switch-selectable emulation makes it a better choice than the 200-dpi (base resolution) GM-6 Plus.

ical variety and have three buttons. Both use a standard serial interface, though only the GM-6000 comes with a 9- to 25-pin adapter for use with ATs. Both come with drivers, menu software, Dr. Halo III, and two nice accessories: a rubber mouse pad that doubles as a self-sealing cutting pad, and a plastic "mouse pocket" that you can stick to your PC or monitor to store the mouse.

The Genius mice, which emulate the Microsoft and Mouse Systems mice, run under their respective drivers. The way you select emulation with each mouse, however, is quite different. The GM-6000 has a sliding switch that lets you select emulation modes on the fly. With the GM-6, you power-up in Mouse Systems mode unless you hold down one of the mouse buttons, in which case you power-up in Microsoft mode. If you want to change emulations, you must power down and then up again. Worst of all, there's no way to permanently set Microsoft emulation as the default on the GM-6 Plus.

The buttons of both mice have a short throw and respond well to double-clicking. Though the buttons are small and close together, you can hit any part of them and still get a solid response.

The GM-6000, at 350 dots per inch, tracks much better than does the 200-dpi GM-6, offering control equal to that of the Logitech HiRez Mouse. I was never quite as comfortable with the GM-6000 as I was with the HiRez, but this is a personal choice.

Unlike those of Logitech, the Genius mice set tracking values from the command line. While this works perfectly well for a single setting, particularly with the GM-6000, it does limit you to one tracking value at a time instead of letting you set tracking values on the fly. If you have different applications, each with a preferred tracking value, you'll need a lot of batch files.

Genius has a good menu creation package, including a menu-driven menu generator that records titles, defines keystrokes, and generates the menu. Nonetheless, these mice lack some of the ergonomic features that I like in a mouse.

The GM-6 Plus compares well with mice reviewed a year ago. Technically, the GM-6000 holds its own with Logitech, but

holding your own is not enough. Even with their clever accessories, the Genius mice are enhanced designs of a mouse that has seen better days.

LOGITECH INC.

Logitech HiRez Mouse Logitech Serial Mouse Logitech Series/2 Mouse

Logitech was a PC Magazine Editor's Choice 2 years running for a good reason: the C-7 mouse design afforded good control and excellent button response at a price to match. Now, though Logitech can still hold its own in the field of contention, all three of its mice are showing their age. (The new Logitech Mouse, which the company plans to introduce this month, evinces greater attention to ergonomic factors. For a fuller description of the beta version of this device, see the sidebar "A New Look for the Logitech Mouse," which accompanies this article.)

Logitech's square wedge case, though



EDITOR'S
CHOICE

FACT FILE

Logitech Inc.
6505 Kaiser Dr.
Fremont, CA 94555
(415) 795-8500

Logitech HiRez Mouse

List Price: \$149 (in bus version only).

Requires: 11K RAM, empty 8-bit expansion slot, DOS 2.0 or later.

CIRCLE 660 ON READER SERVICE CARD

Logitech Serial Mouse

List Price: \$129 (bus version available).

Requires: 11K RAM, RS-232C serial port (bus version requires empty 8-bit expansion slot), DOS 2.0 or later.

CIRCLE 676 ON READER SERVICE CARD

Logitech Series/2 Mouse

List Price: \$99

Requires: 11K RAM, IBM PS/2 computer, DOS 2.0 or later.

CIRCLE 678 ON READER SERVICE CARD

In Short: The Logitech HiRez Mouse outperforms the others with 320-dpi base resolution and dynamic tracking. The Serial Mouse and Series/2 for the PS/2 (both with 200-dpi base resolution) are no longer exceptional and are in need of a makeover.



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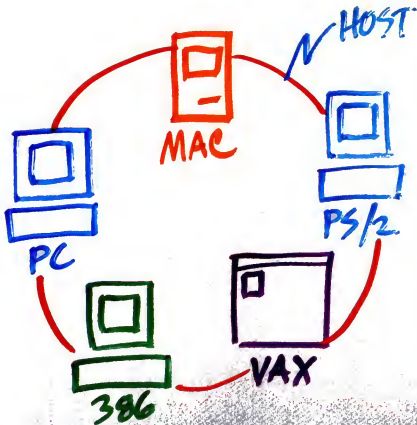
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Mice: Summary of Features

(Products listed in ascending price order)

	Mitel Mouse Mitsubishi International Corp.	Dexxa Mouse DLX Oxxa International	Omelmouse MSC Technologies Inc.	Z-Nix Soger Hi-Res Mouse Z-Nix	IBM PS/2 Mouse IBM Corp.	Geekus GM-6 Plus KYE International Inc.	Logitech Series/2 Mouse Logitech Inc.
List price	\$79.50; with TelePaint, \$94.50	With Paint-W, \$89, with CCS Designer, \$119; with both, \$139; bus version, \$10 higher	\$89	\$95; with Dr. Halo III or PC Paintbrush, \$129.95; with TurboCAD, \$149.95; PS/2 version, \$89.95	\$99	\$99 (with Dr. Halo III)	\$99

GENERAL SPECIFICATIONS

Base resolution (dpi)	200	200	200	340	200	200	200
Position sensor	Optomechanical	Optomechanical	Optomechanical	Mechanical	Mechanical	Optomechanical	Optomechanical
Dynamic tracking	○	● (using software)	○	● (using software)	○	●	● (using software)
Interface	Serial	Serial or bus	Serial	Serial or bus	PS/2 pointing- device port	Serial	PS/2 pointing- device port
Interface for IBM PS/2 NCA	○	○	○	● (PS/2 version only)	●	○	●
Number of buttons	2	2	2	3 (2 on PS/2 version)	2	3	2
Power supply	Internal	Internal	Internal	Internal	Internal	Internal	Internal
Cord length (inches)	58	72	60	95	108	70	108

MENUS

Menu generator	●	●	●	●	○	●	●
Menus included:							
dBASE III (or dBASE III Plus)	○	○	●	○	○	●	○
Framework	○	●	●	○	○	●	●
Javelin	○	○	○	○	○	●	○
Lotus 1-2-3	●	●	●	●	○	●	●
MultiMate	○	○	○	○	○	●	○
MultiPlan	○	○	●	○	○	●	○
Paradox	○	○	●	○	○	○	○
PFS: Professional Write	○	○	●	○	○	●	○
OmniForm	○	○	○	○	○	○	●
R-base Series 5000	○	○	○	○	○	○	○
SuperCalc 3 or 4	○	●	●	○	○	●	●
Symphony	○	●	●	○	○	●	●
Turbo Pascal	○	●	○	○	○	●	○
VisiCalc	○	○	○	○	○	●	○
VP-Planner	○	●	○	○	○	○	●
WordPerfect	●	●	●	●	○	○	●
WordStar	○	○	●	○	○	●	○
XTree	○	●	○	○	○	○	○

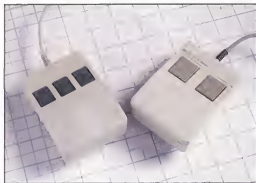
MOUSE EMULATION

Microsoft Mouse (serial/bus)	●/○	●/○	●/●	●/○	○/○	●/○	●/●
Mouse Systems (MSC) Mouse (serial/bus)	○/○	○/○	●/○	●/○	○/○	●/○	●/●
Logitech Mouse (serial/bus)	○/○	○/○	●/●	○/○	○/○	○/○	●/●

●—Editor's Choice ●—Yes ○—No N/A—Not applicable; product does not have this feature N/A—Not applicable; product cannot emulate itself

[illegible]

■ MICE



Logitech's HiRez Mouse is an example of superior engineering: with its 320-dpi base resolution and on-the-fly dynamic tracking, it outperforms other mice. The company's Serial Mouse (not pictured, for it looks just like the Series/2) and Series/2 Mouse offer 200-dpi base resolution, good tracking, and solid button response.

functional, has been surpassed—at least in terms of comfort—by the designs of Key Tronic, Microsoft, and MSC Technologies. Logitech justifies its physical design by maintaining that if you handle the mouse correctly, there's no difference in performance. Cosmetics, according to the people at Logitech, is no match for superior technology.

Logitech's engineering is no doubt superior: its \$149 HiRez Mouse, with true 320-dot-per-inch resolution and on-the-fly dynamic tracking, outperforms other mice. You need a high-resolution monitor to really see and feel what the HiRez can do—it should delight CAD users and other graphics devotees. At 320 dpi, the mouse travels with assurance, and dynamic tracking lets you fly around the screen. You won't sense this at once, but after a time you will notice the difference in control and positioning.

The Serial Mouse and Series/2 Mouse are also well engineered, but though they offer 200-dpi resolution, good tracking, and solid button response, they are no more or less remarkable than other mice with the same specifications. The \$129 Serial Mouse can emulate Microsoft, but is not plug-compatible and will not run under Microsoft drivers. However, you can use Logitech's driver in place of Microsoft's for most applications.

The two-button Series/2 Mouse works well on the PS/2. In competition against the offerings of IBM and Microsoft, however, the \$99 Series/2 has no advantage other than Logitech's reputation for quality and support.

MICROSOFT CORP. Microsoft Mouse

I was smitten with Microsoft's new mouse when I first reviewed it ("From Our Maus to Baumaus: Logitech Versus Microsoft," *PC Magazine*, February 16, 1988), and my feelings haven't changed. Though many of the features of the 200-dot-per-inch mouse are similar to those of others, Microsoft added a few interesting twists.

Microsoft's mouse—which ever version you choose, bus or serial (both range in price from \$150 to \$200)—tracks mechanically with the ubiquitous rolling ball.



The rolling ball in Microsoft's 200-dpi (base resolution) mouse has been moved toward the front, so the case slopes toward the back, making it feel more comfortable than most of the rest. The mouse operates smoothly and effortlessly and always feels solid and well balanced. The mouse comes in bus and serial versions (the latter comes with a PS/2 connector). Both look the same.

But rather than being placed under the palm in back, the rolling ball has been moved toward the mouse's front. Because of this new design, the case slopes toward the back, and the buttons are only slightly curved up front. It now has fewer curves and edges than do the cases of other mice, but the slightly raised center and lower back edge really do make it feel more comfortable than most of the rest.

The mouse operates smoothly and effortlessly. It moves easily over most surfaces and always feels solid and well balanced. Using it, my fingers never feel like they're falling off the edge, as they did with Microsoft's earlier design. One slight problem: though the rolling ball's new positioning has increased the mouse's accuracy, you may find that the cursor jumps if you lean too hard on the back. Moving your hand forward slightly eliminates this.

The mouse still has two buttons, but they're large and flush with the body, with a slightly larger left button. Button response is crisp and direct; it produces a modest, yet audible click.

Microsoft is one of the few mouse manufacturers to offer a true PS/2 mouse port

PC
MAGAZINE

EDITOR'S
CHOICE

FACT FILE

Microsoft Mouse
Microsoft Corp.
16011 NE 36th Way
Box 97017
Redmond, WA 98073-9717
(206) 882-8680
List Price: With Microsoft Paintbrush, \$150; with Microsoft Windows/286 and PC Paintbrush for Windows, \$200; with Easy-CAD 2, \$175.

Requirements: Bus version: 11K RAM (varies according to bundled application running); one double-sided 5¼-inch disk drive; one available expansion slot; DOS 2.0 or later. Serial version: 11K RAM (varies according to bundled application running); one 9- or 25-pin serial port; for PS/2 version, one double-sided 5¼-inch disk drive or one 3½-inch disk drive; DOS 2.0 or later.

In Short: Microsoft sets a high standard that's hard to match, featuring superior design, excellent feel, and solid construction. The serial interface connection box is the only curiosity in an otherwise exceptional two-button, 200-dpi (base resolution) mechanical mouse.

CIRCLE 677 ON READER SERVICE CARD

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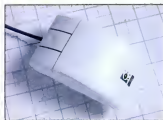


A NEW LOOK FOR THE LOGITECH MOUSE

Emphasizing ergonomics as well as technology, the beta version of Logitech's new mouse has a more comfortable case, 320-dpi resolution, and dynamic tracking.

Finally, the company known for having the best price/performance ratio has embraced ergonomics. Though Logitech's rationale was that cosmetics are no match for superior technology, let's face it: besides being unattractive, Logitech's flat wedge case was never very comfortable. But the \$129 mouse that the company plans to introduce this month should push it to the front of the pack. In addition to a newly designed, comfortable case, the beta version of this new mouse features high resolution and dynamic tracking capabilities.

Logitech could have gotten by with



The beta version of the new Logitech Mouse features 320-dpi base resolution and dynamic tracking that let you maneuver your screen with a mere flick of the wrist. The new case is a smooth arc, with the tracking ball set forward to improve positioning control.



FACT FILE

Logitech Mouse

Logitech Inc.

6505 Kaiser Dr.

Fremont, CA 94555

(415) 795-8500

List Price: \$129, with PaintShow Plus, \$149.

Requires: 11K RAM (384K RAM with pop-up DOS); PS/2 pointing device port or 8-bit expansion slot or RS-232 serial port; DOS 2.1 or later.

In Short: A new ergonomic design, 320-dpi resolution, improved positioning control, and dynamic tracking make the three-button Logitech Mouse, reviewed in its beta release, one of the most comfortable and accurate to use.

CIRCLE 66 ON READER SERVICE CARD

the new case design and just left it at that, but it didn't. The company's new mouse has ergonomics and technology. The case design is a smooth arc 1-inch high, with three flush-mounted buttons spaced evenly across the forward surface. The buttons have feather-touch response, and there's a slight depression on the center button for tactile feedback. Logitech also moved the tracking ball forward to improve positioning control.

The relationship between the case design and resolution are worth noting. With the arc case design your fingers drape naturally over the mouse, so you tend to control it with your fingers rather than with your palm. This finger control is enhanced by a respectable 320-dot-per-inch resolution and on-the-fly dynamic tracking.

COMFORTABLE CONTROL You can work in a generous area of the screen with little hand motion, traversing its length with a flick of the wrist. I found the Logitech Mouse one of the most comfortable to use for extended periods. It performed well in EGA or VGA mode and really showed off on high-resolution monitors like the Wyse WY-700. Throughout testing, the mouse's control and positioning accuracy were exceptional, and its button response was sharp and solid.

Logitech may have given in to ergonomics, but the company is maintaining its turf with distinctive, and often desirable, features. Other mouse manufacturers shun the three-button design; Logitech embraces it. Menu-generating software is optional with many mice; Logitech includes it. Other mice require PS/2 interfaces; Logitech is plug compatible. And so on.—Tom Stanton

interface (IBM and Logitech are others). Microsoft's serial mouse allows connections for 9- and 25-pin serial ports, and the PS/2 connector, through a slender connection box. The bus version uses half a slot on the PC and offers jumper-selectable interrupt settings.

The Microsoft Mouse has raised the stakes in this market. After handling 18 different mice, each with its own idea of ergonomic design, wrapping my hand around the Microsoft mouse was like coming home.

■ Microsoft is one of the few mouse manufacturers to offer a true PS/2 mouse port interface, through a slender connection box.

MITSUBISHI INTERNATIONAL CORP.

E-Mouse Mitsi Mouse

Mitsubishi has produced one really good mouse, the \$179.50 E-Mouse. Superior tracking, good positioning, a comfortable case, high resolution and Microsoft compatibility make this mouse an excellent choice. Unfortunately, Mitsubishi's other mouse, the \$79.50 Mitsi, is best characterized as an evil twin.

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■ MICE



Both the PC Mouse II and Omnimouse represent radical departures for MSC Technologies. The PC Mouse II is still based on optical technology but has only two buttons. It offers variable tracking resolution that can be changed on the fly. The optomechanical Omnimouse has two buttons and operates comparably to other mechanical mice. Both mice have 200-dpi base resolution.

blance to its predecessors and was obviously designed to go head-to-head with the new Microsoft Mouse. The optical technology remains, but that's about all. The PC Mouse II has but two large buttons that are aligned flush with the case, a unique raised-wedge shape, and offers on-the-fly tracking resolution.

The new design feels comfortable and works well. Buttons have a crisp, sharp response and double-click with little effort. The mouse moves easily across the pad

as needed within most applications using a TSR built into the PC Mouse II driver. MSC uses the popular Ctrl-Alt hotkeys—not the wisest choice—which means you have to adjust other TSRs to use a less popular combination.

Dichard fans of the three-button design, rest assured: MSC plans to continue offering the older three-button design, but with the latest software. In any event, MSC has created a worthy successor that deserves serious attention. As long as the optical pad does not cramp your style, you'll enjoy using the PC Mouse II.

As an optomechanical mouse, the Omnimouse represents a complete departure for MSC. A two-button, 200-dot-per-inch mouse that emulates Microsoft's, it comes with a standard serial interface, 9- to 25-pin adapter, and runs under its own drivers as well as those of Microsoft. Its plug compatibility is so good that I simply took the Omnimouse out of its box, connected it, and started mousing.

Omnimouse operation is comparable to that of other mechanical mice. It moves well on most surfaces and tested well on all applications. I found the case somewhat bulky and not immediately comfortable to use, but after an hour of scrolling and clicking, I felt no fatigue.

The two large buttons have a solid response—perhaps too solid. Omnimouse buttons respond much better along the front edge and are very heavy along the back edge. This runs contrary to most mouse button design, where the buttons

have the same response anywhere on their surface. For this reason, you may want to road test the Omnimouse for a few days to see how it feels.

While it is not the optomechanical version of the PC Mouse II (even though it ought to be), Omnimouse will be just fine for some users. It offers excellent compatibility, solid mouse motion, and MSC's menu software. Some users may not find the buttons quite as heavy as I did, so you should test drive Omnimouse if you can. If the buttons don't bother you, it's an excellent choice.



EDITOR'S CHOICE

- Key Tronic Professional Series Mouse
- Logitech HiRez Mouse
- Microsoft Mouse
- E-Mouse

For their ergonomic design, the Key Tronic Professional Series Mouse and the Microsoft Mouse are the clear winners. They handle well and are comfortable to use—proof that good design can be more than just a pretty package.

The Logitech HiRez Mouse and Mitsubishi's E-Mouse stand out for their technical capabilities. Although there are higher-resolution mice than Logitech's 320-dot-per-inch device, none work with as much aplomb. Mitsubishi's 400-dpi mouse combines ergonomic case design with high resolution, making the device a pleasure to use. If the E-Mouse's buttons had a smoother, sharper response, it would have been the overwhelming favorite.

Also keep in mind the new 320-dpi Logitech Mouse that the company plans to introduce this month and that we examined in its beta release. With a more-comfortable arched case and improved positioning control, this mouse can stand up to the toughest competition.

■ As an optomechanical mouse, the 200-dot-per-inch Omnimouse represents a complete departure for MSC. It runs under its own drivers, as well as Microsoft's.

and tests exceptionally well, drawing tight curves or editing thin lines. Even within the boundary of the optical pad, the PC Mouse II holds its own.

The PC Mouse II's variable tracking resolution works very well and can be set



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CIRCLE 350 ON READER SERVICE CARD



Mitsubishi's E-Mouse's 400-dpi base resolution makes it incredibly easy to use, and the gentle curves of its teardrop-shaped case fit the hand well. It handles smoothly, but though its buttons work well, they're not as good as those found on other mice. The 200-dpi (base resolution) Mitsi Mouse performs well mechanically, but it is not particularly comfortable to use.

when I installed them on COM1. It seems that they expect to be connected to COM2 on systems with two COM ports. If you want to use COM1, you need a /I command line switch to identify the port. Other mouse software automatically detects which port you're using, so I had little tolerance for this quirk.

MSC TECHNOLOGIES INC.

Omnimouse PC Mouse II

From the maker of the first mouse come two very different mice, the \$149 PC Mouse II and \$89 Omnimouse. Both represent radical departures for the company, whose three-button design, optical technology, and low wedge shape influenced the industry, setting the stage for the marketing debate that seems to have concluded this year. Perhaps these changes are symbolized by the company's name change: what was once Mouse Systems has metamorphosed into MSC Technologies.

The PC Mouse II bears little resemblance

PC MAGAZINE FACT FILE

MSC Technologies Inc.
47505 Seabridge Dr.
Fremont, CA 94538
(415) 656-1117

Omnimouse

List Price: \$89
Requires: 11K RAM, RS-232C serial communications port, DOS 2.0 or later.

CIRCLE #79 ON READER SERVICE CARD

PC Mouse II

List Price: serial or bus version, with PC Paint Plus or Magician, \$149; with AutoSketch, \$179.

Requires: 11K RAM, RS-232C serial port or empty 8-bit expansion slot, DOS 2.0 or later.

CIRCLE #79 ON READER SERVICE CARD

In Short: The two-button 200-dpi (base resolution) Omnimouse offers an average optomechanical design with heavy buttons, but good Microsoft compatibility. The more sophisticated two-button 200-dpi (base resolution) optical PC Mouse II features the improvements of crisp response, a streamlined body, and ballistic motion.

PC MAGAZINE EDITOR'S CHOICE FACT FILE

Mitsubishi International Corp.
520 Madison Ave.
New York, NY 10022
(212) 605-2607
(800) 232-5727

E-Mouse

List Price: \$179.50; with EGA-Point, \$224.50; with DraftCAD, \$249.50; with Byline, \$329.50.

Requires: 8K RAM, RS-232C serial port, DOS 1.0 or later.

CIRCLE #79 ON READER SERVICE CARD

Mitsi Mouse

List Price: \$134.50; with EGA-Point, \$179.50; with DraftCAD, \$199.50; with Byline 2.0, \$289.50.

Requires: 8K RAM, RS-232C serial port, DOS 1.0 or later.

CIRCLE #79 ON READER SERVICE CARD

In Short: The 200-dpi (base resolution) two-button Mitsi Mouse looks and feels like a prototype brought to market. The two-button E-Mouse, at 400-dpi base resolution, handles like a pro. Neither mouse has great buttons, but you can get used to them.

If you have a high-resolution monitor, you should take a serious look at the E-Mouse, for its 400-dot-per-inch resolution makes it incredibly easy to use: with this magnitude of mouse resolution, who needs dynamic tracking? Positioning is effortless and accurate anywhere on the screen: I needed an area 2 by 3 inches to cover a 1,200- by 800-pixel screen; in

EGA I barely had to move my hand. The mouse is so sensitive that my tendency to grip mice showed up as a fluttering cursor. Once I relaxed, the cursor moved smoothly and surely.

The E-Mouse's case is made of high-gloss plastic like that of Microsoft. Designed for extended work, it is teardrop-shaped, with gentle curves that fit the hand well. It handles smoothly, but though its buttons work well, they're not as good as those found on other mice. They double-click well enough, but the effort is out of proportion with the rest of the E-Mouse. This would be a perfect mouse if the buttons had a softer, sharper response.

The E-Mouse can work with any Microsoft driver without losing its high resolution. Mice with dynamic tracking usually need to have their own driver installed; in contrast, the E-Mouse works anywhere.

The best things I can say about the "evil twin" Mitsi Mouse are that it performs well mechanically and works well with Microsoft. It is not particularly comfortable to use, for its wedge case is rounded toward the top, and my hand sought a resting place toward the back, right over the rolling ball. In extended-use drawing, my hand just got tired of adapting to the shape. The Mitsi Mouse's buttons always felt sluggish, lacking the sharp, crisp response of most other mice. They feature short travel, but feel hard and don't double-click well—sometimes it took several tries to get double-clicking to work.

I had trouble with both Mitsubishi mice

■ MICE

NUMONICS CORP.

Manager Mouse Manager Mouse Cordless

The Manager Mouse and the Manager Mouse Cordless are identical in design and features; the only differences are the presence (or absence) of a cord and the price: the Manager Mouse sells for \$109, or \$129 with *Dr. Halo III*; the cordless mouse lists for \$179, or \$199 with *Dr. Halo III*. The

two have remained largely unchanged since we reviewed them in 1987. Both mice have a boxy case and three small, slender buttons on a gently sloped front face.

Unlike most mice, the Manager uses wheel tracking to detect and report mouse motion. At first these mice appear to work just like their rolling-ball counterparts, but the wheel design does have some quirks. The small plastic wheels slip occasionally, particularly on smooth surfaces, and diagonal motion feels choppy. I found it nearly impossible to duplicate the quick, easy, fluid motion of ball mice with these wheel mice; extended use in *PC Paintbrush Plus* really highlights the mice's design deficiencies.

To its credit, the Manager Mouse Cordless points the way toward what a mouse interface should be: After all, how many other mice can you use on the other side of a room? The mouse is especially good for demos and teaching, where a cord would get in the way. I found it very easy to operate, despite its wheels. The infrared sensor shows all mouse activity, telling you when you're out of communication range. All you have to do is remember to keep this mouse charged.

If Numonics adopted the rolling ball, its 100-dpi mice would be on a par with most others, but the choppy tracking of the wheel will break you. A slick new case for the Cordless, a roller ball, and a mouse pocket that doubles as a charger would make Numonics a major contender. Maybe next year.

Z-NIX

Z-Nix Super Hi-Res Mouse

Often when a product is named "super," it sets you up for a disappointment. Unfortunately, Z-Nix's \$95 Super Hi-Res Mouse is just such a product. It is unremarkable in design and execution, and I found it to be one of the least responsive mice of all we tested.

The Super Hi-Res Mouse mimics Microsoft's older teardrop-shaped body, but adds a twist: instead of two buttons, it has three. The far-left button is shorter than the rest, which I suppose makes it easier to find, but it also means that you need to stretch to get at the most frequently used button.

Even with 340-dot-per-inch resolution, the Super Hi-Res Mouse felt sluggish, even sticky at times, as though the ball or rollers were catching on something. I inspected everything and found nothing sticking, but the feeling persisted on a variety of surfaces. A mouse pad helps, and Z-Nix should include one or improve its mouse's mechanism.

Menu software exists but is not really documented. The *Lotus 1-2-3* menu I tested was obviously not a finished prod-



FACT FILE

Numonics Corp.
101 Commerce Dr.
Montgomeryville, PA 18936
(215) 362-2766

Manager Mouse
List Price: \$109; with *Dr. Halo III*, \$129.
Requires: 18K RAM, RS-232C serial port,
DOS 2.0 or later.

CIRCLE #72 ON READER SERVICE CARD

Manager Mouse Cordless
List Price: \$179; with *Dr. Halo III*, \$199.
Requires: 18K RAM, RS-232C serial port,
DOS 2.0 or later.

CIRCLE #71 ON READER SERVICE CARD

In Short: Wheel tracking, three buttons, and a boxy design date these 100-dpi (base resolution) mice. Manager Mouse does not track easily and offers no exceptional features. Manager Mouse Cordless is a great idea that needs new packaging. Not bad mice, but not great ones either.



The Manager Mouse and Manager Mouse Cordless offer the same design and features. Their wheel tracking design has some quirks, for the small plastic wheels slip occasionally and diagonal motion feels choppy. To its credit, the Manager Mouse Cordless points the way toward what a mouse interface should be.



FACT FILE

Z-Nix Super Hi-Res Mouse

Z-Nix
Distributed by IMSI:
1299 4th St.
San Rafael, CA 94901
(415) 454-7101
(800) 222-4723 (sales, outside CA)
(213) 493-2516 Z-Nix sales office
List Price: Bus or serial version, \$95; with
Dr. Halo III or *PC Paintbrush*, \$129.95; with
TurboCAD, \$149.95; PS/2 version, \$89.95;
Z-Nix Hi-Res Mouse, \$75.

Requires: 4K RAM, RS-232C standard serial port or 8-bit expansion slot for bus version, bus card (included with package), DOS 2.0 or later. Serial mice come with a 9- to 25-pin converter.

In Short: With a short third button—a seeming bow to ergonomics—this 340-dpi (base resolution) mechanical mouse is sluggish and bulky; generally behind the times.

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A three-button mouse with a teardrop-shaped body similar to Microsoft's old one, the Z-Nix Super Hi-Res Mouse features a base resolution of 340 dpi. Unlike some other mice, the Super Hi-Res Mouse does not seem to glide effortlessly across a surface, feeling sluggish and even sticky at times. This feeling is diminished when the mouse is used with a mouse pad.

■ The Super Hi-Res Mouse does shine in Microsoft emulation, and it is accurate in tight drawing tests, although even with 340-dpi resolution, it felt sluggish.

uct—a fact underscored by references to what an OEM could do with the menu software. Z-Nix should either perfect the included menus or eliminate them from the package altogether.

The Super Hi-Res Mouse does shine in Microsoft emulation, and it is accurate in tight drawing tests. Nonetheless, this product lacks the polish in both design and execution to be a top contender. [E]

Tom Stanton is a frequent contributor to PC Magazine.

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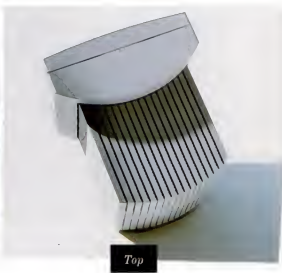
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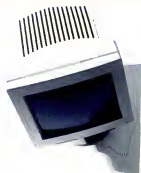
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■ PC LAB NOTES: PC-BASED CADD ■ JEFF PROSISE

CADD PROGRAMS COME OF AGE

If you think computer-aided drafting and design is only for engineers and mainframes, you're behind the times. Here's how to put CADD to work on your own PC.

A new type of software is rapidly entering the ranks of such established major categories as word processors, spreadsheets, and databases. Once the exclusive preserve of corporate engineering departments equipped with expensive mainframes and minicomputers, CADD systems have dropped both in price and computing requirements right into the environment of the office PC. Yet while many users could profit by using CADD programs, they remain largely unknown outside engineering circles.

Spreadsheets offer an instructive parallel. When you saw your first electronic spreadsheet, you probably thought, "Gee, that's a neat tool—but I don't have a lot of applications for it." But *Lotus 1-2-3* long ago outgrew its roots in the accounting world. Engineers began using it to analyze their designs, home builders began using it to keep track of materials and construction costs, and doctors began using it to keep billing records.

Similarly, while CADD has single-handedly revolutionized the architecture and engineering industries, you don't have to be an engineer to reap its benefits. CADD is for everyone. And now that inexpensive CADD software can be had for less than the cost of a good word processor, it has suddenly been thrust within reach of the average user.

This PC Lab Notes will look at CADD from the perspective of the typical home or business PC user. I'll try to explain its terminology and basic concepts and show you some of the everyday situations where CADD can increase the level of your own

productivity. Hopefully, that will be enough for you to decide that a CADD package deserves a place on the shelf right alongside your favorite spreadsheet or word processor.

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WHAT IS CADD? CADD is an acronym for computer-aided drafting and design. Simply put, it gives you a way to create precise sketches and pictures on your PC that are comparable to what a skilled artist or draftsman would create on paper using rulers, T squares, and other tools of the trade. CADD programs are similar to the mouse-driven paint programs made popular by the Macintosh, but they lean more toward detailed, scaled images than free-hand drawings.

With CADD you can whip up a quick diagram to include in a memo you're preparing on your word processor, create a scale model of your office to experiment with different furniture arrangements, or create a pictorial information database. One of the great benefits of CADD is that once you've done the work up front to create an image, you can go back and edit it as many times as you like without compromising its integrity. And CADD programs pack an arsenal of features that make editing easy.

Consider the steps that you would take to create a simple sketch of the floor plan of your house. You would start by selecting a sheet of paper and choosing a drawing scale that would let you fit the entire plan on a single sheet. With CADD software, you go through the same process. Select a sheet size and a drawing scale, and the borders of the blank page are displayed on your screen. Unlike your hand drawing, however, if the entire page won't fit on the screen, with CADD you can zoom out until it does or zoom in until you're at a comfortable range, and then pan around to

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reach different parts of the page.

On paper, next you'd make an outline of the interior and exterior walls using a ruler or triangle to draw the lines straight and to make sure they intersect at right angles. With CADD, no straightedge is required. To generate a line, you simply choose the LINE function from a menu and use your mouse to point to the spot where one end of the line should be anchored. Then you'd either type in numbers indicating the length and direction of the line or you'd point to where the other end should fall. The CADD program draws the line between the two points.

A number of standard CADD facilities expedite the drawing process. You can set up a grid of points spaced 1 foot apart and instruct the CADD software to "snap" the pointer to the nearest grid point. That makes short work of laying down a series of precisely positioned parallel and perpendicular lines. Once the outline of the house is roughed in, you can refine the grid to one point every 4 inches and zoom in on each room to add finer detail. And if a line is accidentally misplaced or drawn to the wrong length, you can erase it simply by clicking on it with the mouse or by instructing the program to trim the line back to its intersection with another line.

With the floor plan complete, you'll want to add some dimensions to show the size of each room and the overall length and width of the house. This is where CADD really shines. It already knows the lengths and locations of the lines you've created, so when you select any two points, the CADD program calculates the distance between them and displays it in the units and scale you specify. And thanks to a feature known as *associative dimensioning* (which permanently ties the dimension you just created to the two points you indicated), the dimension is automatically updated if you later return and stretch the line to add 3 feet to the length of the room.

As a final touch, you might add a few lines of text to indicate the square footage and the name of each room. CADD programs let you enter text in the style, size, and color of your choice; then you can paste it into the drawing. Some CADD programs will even calculate the square feet for you. You'd finish up by saving the

final product to disk where it can be recalled for editing later. As you become an experienced CADD user, you'll find that you're sending your sketch to be printed while the other guy is still trying to pencil over his mistakes.

PUTTING CADD TO WORK CADD programs are good for much more than generating house plans. We all know that often a simple sketch is the best way to convey an idea, and CADD lets us put a picture in place of a thousand words. Now we can have the best of both worlds, since word processors are being designed to incorporate CADD graphics.

WordPerfect, Version 5.0, has done a particularly complete job of bridging the gap between traditional word processors and desktop publishers by offering the ability to include graphics as well as text in word processing documents. Given a pictorial bitmap image stored on-disk, *WordPerfect* will bring it in, let you resize it and move it around, and wrap words around it in such a way that there's no collision be-

tween graphics and text. It even includes a small library of useful clip-art images to save you the time of coming up with them from scratch.

What *WordPerfect* doesn't give you is a way to create these images from within itself. The program can, however, import files in a variety of graphics formats and convert them into its own native .WPG (for *WordPerfect* Graphics) format. One of the formats it supports is known as .DXF, which is a neutral file format developed by the makers of *AutoCAD* that is supported by most PC CADD vendors. Hence, if you need a graphic for *WordPerfect* 5.0 and have a CADD system, you can draw your picture, save it as a .DXF file, and read it straight into your *WordPerfect* document.

Many desktop publishing programs also support .DXF files. *WordPerfect* will even import *AutoCAD* files directly, without intermediate translation to .DXF. If you're involved with desktop publishing or graphics-oriented word processing even in a small way, CADD is your ticket to at-

SPEAKING THE CADD LANGUAGE

Like other specialized fields, the CADD (computer-aided drafting and design) world has developed its own terminology. Some of it was handed down from the days when CADD ran only on mainframes and minicomputers; the rest of it was added after the technology was adapted to PCs. To help you learn something about its phraseology, here's a short glossary of key CADD terms that will let you hold your own when CADD buzzwords are being shot back and forth like so many arrows.

Associative dimensioning A feature that ties dimensions to specific pieces of geometry in such a way that when the geometry is changed, the dimensions automatically change with it.

Attribute Intrinsic information that may be attached to a drawn object for purposes of data storage and management. For example, a window on an architectural drawing might be *attributed* with the text string "3 x 4" to designate its di-

mensions as 3 by 4 feet.

Through the process of *attribute extraction*, the information attached to this and all other windows in the drawing can be gathered and written to an ASCII file. Once stored in an external file, the information is typically used in a list of materials or manipulated by a database program.

CADD (computer-aided drafting and design) Also the name for an entire category of computerized drawing programs.

CAM (computer-aided manufacturing) The technology by means of which manufacturing needs are fulfilled by computer. One example of a typical CAM application is using CADD systems to produce the tapes needed to drive numerically controlled manufacturing and inspection machines.

CIM (computer-integrated manufacturing) The integration of CADD and CAM to achieve the goal of completely automating factories.

tractive documents and lively graphics.

CADD can help in other areas, too. How many times have you decided to rearrange the furniture in your office and reached for a tape measure for help in matching potential arrangements to the size of your workspace? Maybe you've even gone so far as to cut out paper models scaled to match the size of your desk, tables, and chairs, then toyed with different combinations of orientation and position. If so, you're a perfect candidate for CADD.

Most CADD programs will let you grab an object with the mouse pointer and drag it around the screen. To take advantage of this in laying out an office area, you'd simply set up a rectangle scaled to match the length and width of the room, then create another rectangle for each item of furniture. To keep them straight, you might label each item with a simple line of text denoting its size and function. Then move them around at will. If two items won't fit when placed end to end along a wall or wedged together in a corner, you'll see the

overlap on the screen and save the useless labor of trying to muscle the real pieces into position. And when you've found a satisfactory arrangement, you can save it to disk for next time.

■ Landscaping calls for planning ahead. And a CADD program is perfect for the job of preplanning and experimenting.

Another place where you might put CADD to work for you is in landscaping. If you're like me, you like to work in the yard, planting trees and shrubs and adding touches of greenery to increase the visual appeal. But if you go about it in a random, unplanned fashion, the results look hap-

hazard. If there's anything worse than spending an afternoon digging a hole for a tree in dry, sun-baked earth, it's digging another hole for the same tree when it doesn't look right where you first put it.

Landscaping calls for planning ahead. And a CADD program is perfect for the job of preplanning and experimenting. CADD lets you play what-if with pictures the same way a spreadsheet lets you play what-if with financial data. I have a CADD drawing file with the outline of my house, yard, driveway, sidewalks, and the street that borders my front yard sketched in. When I begin a new landscaping project, I try out my ideas on the screen before investing a penny in materials or digging the first hole. If I don't like what I see on the screen, I tinker with it until I settle on a satisfactory scheme—or until I decide to scrap the idea altogether. And when I do decide on a plan, I make sure to save it along with the master drawing file so that the changes are documented.

One of the many ways that CADD helps in such projects is by maintaining a

Digitizing tablet A peripheral input device (usually accompanied by an electronic pen or puck and menu overlays) that allows drawing operations to be selected and performed off the screen rather than on it.

.DXF (drawing exchange file) .DXF is a neutral file format developed by Autodesk, makers of AutoCAD, that is suitable for the exchange of 2-D drawing files between CADD programs.

Hidden-line removal The process of hiding lines on a wireframe model that would be obscured by surfaces closer to the eye, thus producing the visual effect of a surface.

IGES (Initial Graphics Exchange Specification) IGES is a neutral file format established by the American National Standards Institute for the exchange of 2-D or 3-D drawing files.

Layering The act or method of dividing the elements of a single drawing among a number of individual pages, or *layers*.

This technique is widely used for organizational purposes. Layers may be visualized as cellophane cells that, when stacked on top of one another, make up a complete picture of the drawing.

Panning The act of moving the window represented by the CRT screen around to view different portions of a drawing.

Plotter A high-quality graphics output device consisting of a two-dimensional mechanism that drives one or more colored pens across the surface of a sheet of paper to produce a rendering of what appears on a CRT screen.

Shaded rendering A means of displaying an object in which surfaces are colored and shaded to produce a visually realistic effect.

Snapping A means of automatically selecting coordinating points when creating a drawing. For example, if endpoint snapping is activated, the user need only indicate a point anywhere on the line in order to select the endpoint of the line.

The CADD program will automatically determine which end of the line is closer and snap the screen cursor to it.

Solid modeling A means of representing an object as an unambiguous mathematical solid rather than as a wireframe or surface model.

Surface modeling A means of representing an object as a collection of bounding surfaces.

Symbol A picture that can be inserted into a CADD drawing at the location, size, and angle of the user's choice. For example, a graphic depicting a window can be stored as a symbol and used in multiple instances on the elevation of a house. Symbols are also called blocks.

Wireframe A method of representing an object by showing only the lines and curves that constitute its edges. With this technique, the eye must supply its own interpretation of the model to achieve the impression of surfacing.

—Jeff Prossie

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symbol library. A symbol is a picture that can be inserted into a drawing as many times in as many places as you like. Symbols save time when a number of identical objects are to be placed in a drawing. The CADD program lets you create the object once, save it as a symbol, and call it back whenever it's needed.

Thus, if you're working on a landscaping plan, for example, you might construct a circle with lines emanating from the center, representing a shrub. You then save it as a symbol and simply paste it into the drawing wherever a shrub is needed. The same symbol can double as a tree if you simply scale it up by a factor of 4 or 5 when you recall it from the library. Most CADD programs will let you shrink, expand, and rotate a symbol prior to placing it.

Most professional CADD users develop custom symbol libraries of their own. An architect, for instance, will create a symbol library that includes objects such as door swings, water closets, bathtubs, sinks, and windows. After drawing each item once, he never has to draw it again unless he wants to change it or make a new one that's a slight variation on the old.

Symbols needn't be limited to small ob-

jects. An entire drawing can be converted into a symbol and pasted on top of another drawing. Thus, if there's a standard form you want to use on each of your drawings—such as a border with your company's logo or letterhead—you can make a pattern out of it by saving it as a symbol. Then each time you start a new drawing, you can retrieve the pattern from disk and add it to the new file.

BEYOND SYMBOLISM The use of symbols isn't the only way that CADD lets you reduce the amount of time spent duplicating geometric shapes. Any object or group of objects you draw can be selectively mirrored, copied, or moved to another location. Objects can also be duplicated in rectangular or circular arrays.

The classic example of how generating a circular array can save time is the construction of a gear. Each tooth of the gear is composed of identically connected arcs and lines joined to the inner circle that forms the circumference of the gear body. Creating each tooth individually in the proper orientation would be an enormous task. But with CADD, all you need to do is draw one-half of a tooth, mirror and copy it

to make the adjoining half, then duplicate the resulting tooth in a circular array.

You can also set up a CADD drawing to serve as a visual database. Using a process known as *attributing*, information can be attached to individual objects or symbols in a drawing and later extracted and transferred to an external ASCII file. There the information is typically used in a list of materials or imported into a database program such as *dBASE III* or *Paradox*.

Consider, for example, the possibility of setting up a graphical point-and-shoot

■ Most CADD programs will let you shrink, expand, and rotate a symbol prior to placing it.

database to store information about the members of your staff. You could start by sketching up a quick organization chart, with each staff member's name occupying

CADD HARDWARE REQUIREMENTS

Many prospective users believe that setting a PC up for serious CADD work requires megabytes of RAM, a hard disk, an expensive graphics card, a math coprocessor, a digitizing tablet, a plotter, and a souped-up 286 or 386 machine running at 12 MHz or better.

Tain't necessarily so. While outfitting your machine with all of the above will give you the most awesome CADD system on the block, not all these items are required to get up and running. Many CADD systems will run acceptably with a plain old CGA video card or a Hercules monochrome card. An EGA has sufficient resolution to tackle all but the most complex designs. Megabytes of RAM can be great, but many CADD programs can't use anything beyond 640K.

Plotters are far too expensive to consider unless you're preparing for high-

volume production work. A standard dot matrix or laser printer suffices for most purposes. A mouse is often as good as a digitizing tablet, and many CADD programs even allow for input to come entirely from the keyboard.

And as for the 286 or 386 CPU—well, it helps, because CADD programs are necessarily graphics-intensive, and graphics-intensive means computation-intensive. But like most other products, CADD software will run on an 8086 or 8088, though with a commensurate sacrifice in speed.

The one item you shouldn't be without for CADD work is a numeric coprocessor. CADD programs rely heavily on floating-point calculations and thus benefit directly from dedicated math hardware. *AutoCAD* is one of the few packages that require a coprocessor. If

you opt to go without one, expect a tenfold decrease in drawing performance. Circles that pop instantly into view with a math coprocessor installed are slowly painted on the screen a pixel at a time without one. There's a substantial penalty to be paid in productivity when a drawing takes 60 seconds to regenerate rather than 6.

I consider a minimal CADD hardware configuration to consist of a hard disk, a graphics card and a compatible monitor, a mouse, and a math coprocessor. Some programs require a hard disk; others don't. An EGA and a relatively fast machine are recommended but not required. Anything more should be justified by the complexity of the task at hand or by heavy use, and anything less may make CADD more of a hindrance than a help.

—Jeff Prossie

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a box. To each box you could add information such as job title, years with the company, and area of expertise. This additional information would be put in the form of unseen text attributes, which would be displayed only when you specifically asked for them. With some CADD programs, you could design your system so that clicking on a box would bring up a display of all recorded information for that person. Or you could use the program's attribute extraction feature to generate a snapshot of personnel profile of your entire organization.

3-D CADD CADD isn't limited to producing two-dimensional pictures and drawings. Many of the CADD programs available for the PC are capable of modeling objects in full 3-D. Each point on the object is assigned x, y, and z coordinates, and the viewpoint representing the position of the operator's eye within the frame of the model can be shifted to show the object from any angle or distance. A simple cube that looks like a square in a 2-D drawing takes on added impact when viewed from a point in space that shows three of its sides.

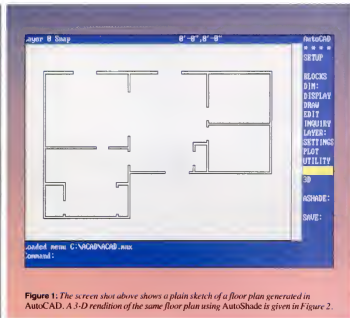


Figure 1: The screen shot above shows a plain sketch of a floor plan generated in AutoCAD. A 3-D rendition of the same floor plan using AutoShade is given in Figure 2.

A BUYER'S GUIDE TO CADD SOFTWARE FOR THE PC

There are two distinct classes of competitors in the race to bring high-power CADD software to the PC: those costing roughly \$500 and less, and those costing up to \$3,000 and beyond. Among the lower-cost entrants belong such impressive performers as *Generic CADD* and *Drafix 1 Plus*, which give you modest power and utility at a humble price. In the upper-price echelons, products like *AutoCAD*, *Cadkey*, *MicroStation PC*, and *VersaCAD* battle for market share. While all are useful packages in their own right, they're targeted more for the corporate user buying CADD software with company dollars than for the nontechnical user.

For home and business use, you're just about as well off with an inexpensive CADD program if you buy carefully and match its features to what you want to do

with the software. The under-\$500 products generally perform as well as their higher-priced counterparts but offer fewer features. That's fine if you have no desire for the built-in power of an *AutoCAD* or for its expandable *AutoLISP* programming capabilities, but don't expect a low-end product to accommodate such refinements.

You'll find a thorough and useful suite of reviews of low-cost CADD packages in the article "Upwardly Mobile CADD," which appeared in the December 8, 1987, issue of *PC Magazine*. High-end products were examined in *PC Magazine* in "Expanding to New Dimensions," August 1988.

As in purchasing software of any type, it pays to look before you leap when you're ready to make the move to CADD.—Jeff Prossie

But what really brings an object to life is its transformation from a simple wireframe model to a lifelike shaded rendering. An object in wireframe form is represented only by the lines and curves that define its edges. A wireframe cube, for example, is composed of 12 lines, and all 12 can be seen from any viewing perspective. Without adding the ability to remove hidden lines, there is no masking of the lines that lie behind surfaces positioned closer to the eye. By contrast, a shaded rendering shows the *surfaces* that make up an object. Surfaces that are obscured by other surfaces are thus hidden from view, and surfaces that are visible are shaded according to the intensity and relative position of an unseen light source.

Some CADD programs with shaded rendering capabilities even offer *perspective viewing*, in which all parallel lines converge at an infinite point on the horizon. With perspective applied, an object loses the clinical drawing-board look and seemingly springs to life. In terms of visual realism, shaded renderings drawn in perspective are the best that PC-based

CADD systems can currently offer. As recently as a few years ago, however, shaded images were beyond even many of the powerful mainframe computers. Higher-performance computing engines and improved computer graphics algorithms have made shaded renderings possible at all cost levels.

Most rendering programs are sold separately from their parent CADD programs. *AutoShade*, for example, is an add-on that accepts *AutoCAD* drawing files and produces shaded renderings from them. Cad-key markets a *Solids Synthesis* package that generates detailed shaded images from *Cadkey* drawing files.

If a simple 2-D sketch helps to get your point across, a 3-D shaded rendering will really drive it home. The screen shot in Figure 1 illustrates a plain sketch of a floor plan generated in *AutoCAD*. Figure 2 shows the same plan displayed as a 3-D wireframe in *AutoShade*, with the lines defining the walls extruded into surfaces. Figure 3 shows the entire scene displayed as a shaded rendering on an EGA video adapter. The shading makes it easier to imagine what the final product will look like.

The difference is clearly dramatic. The

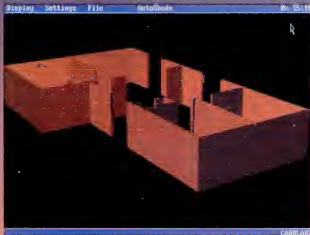


Figure 3: The entire floor plan displayed as a shaded rendering on an EGA video adapter. The shading makes it easier to imagine what the final product will look like.

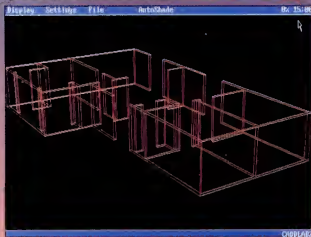


Figure 2: The same floor plan (shown in Figure 1) displayed as a 3-D wireframe model in *AutoShade*, with the lines defining the walls extruded into surfaces.

3-D wireframe image makes it much easier to visualize what the final product—in this case the interior of a house—will actually look like. The shaded image helps even more. Given additional time, the model could be developed in much finer detail and even embellished with doors, windows, and furniture. The only limit is your imagination.

MORE-EFFICIENT CADD After becoming acquainted with a CADD program, there are a number of steps you can take to make your work more efficient. CADD doesn't stop at helping you create drawings; it also helps you organize them and use the information in them.

One of the ways CADD helps you organize your drawings is by implementing the concept of *layering*. Imagine a drawing not as a single sheet of paper but as a vertical stack of clear cellophane pages. If you're developing plan-view drawings for a two-story house, you might draw the first floor on one page, the second floor on a second page, plumbing on a third, heating and air-conditioning ducts on a fourth, di-

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We have one thing to say to the people who keep getting personal about PROCOMM PLUS.

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John C. Dvorak,
columnist, PC Magazine

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CIRCLE 504 ON READER SERVICE CARD

mensions on a fifth, and notes on a sixth. Stack them on top of each other, and you get a complete picture. But pick any one page out of the stack and you get a clear, uncluttered view of what's on it.

CADD drawings are structured the same way. When you work with CADD, you draw on one layer at a time and switch back and forth between layers to develop the drawing fully. The layer you're drawing on is known as the current, or active,

layer. CADD programs generally let you display one layer, all layers, or any combination of layers at one time. Layering helps you keep the discrete elements of your drawing separated without having to keep them in separate drawing files.

Figure 4 shows how one house plan was broken into layers in the early stages of development. The first layer holds the outline of the walls, the second-layer symbols represent the swinging and sliding

THE CADD REVOLUTION

The impact of computer-aided drafting and design on the fields of architecture and engineering can be compared with the impact of the Industrial Revolution on American industry. It has permanently changed the way we do business, so that a company that doesn't upgrade to take advantage of recent advances in computer technology is doomed to fall behind the rest in terms of efficiency, productivity, and product quality. The rush is on as design houses make the transition from drafting board to computer screen and factories both domestic and foreign race to implement the latest in CIM (computer-integrated manufacturing) technology.

In the old days, architecture and engineering organizations relied upon rooms full of draftsmen bent diligently over drafting boards to produce blueprints of their designs. Their primary tools were the T square, the triangle, and the lead pencil. Look at what's around you—a building, the floor plan of your kitchen, the sheet metal box that houses your computer, or the desk that stands in the corner of your den—and you'll notice that everything is primarily composed of straight lines coming neatly together at very precise angles.

Before any of these objects existed, they were carefully laid out on a drawing board. Chances are, the designs were changed—sent “back to the drawing board”—many times before they were ready to be transferred from the drawing board to the manufacturing floor. If you blow the dust off an old drawing, you'll

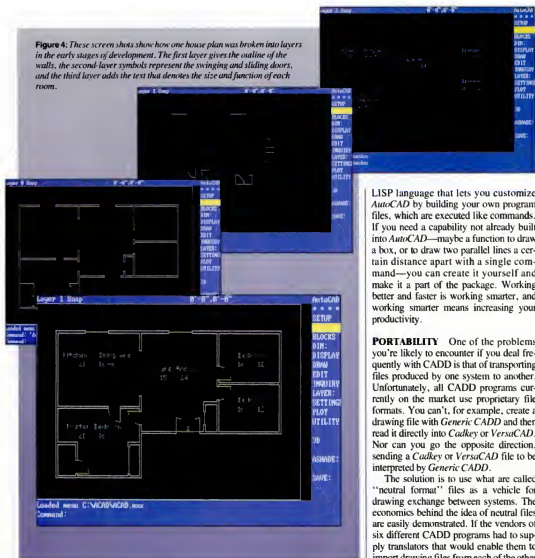
often see spots where the paper is almost worn through as a result of so many erasures.

The same idea of crafting and recrafting a design is still followed today, of course, but the drawing board is rapidly becoming as much a relic as the slide rule. With CADD, drawings are produced on the CRT screen in far less time than it would take on a drawing board. Changes are made much more easily and leave no messy eraser marks or smudged pencil lead. And drawing files are stored safely away on-disk, where they can be retrieved undamaged years later and reproduced on paper with the aid of a plotter. Better still, drawings produced electronically can be zipped across the country in minutes over conventional telephone lines, eliminating the once costly and time-consuming process of shipping paper drawings from one location to another.

CADD even helps in the post-design phase. Some CADD systems can eliminate the drudgery involved in analyzing a design by automatically calculating the area of a floor plan or the mass centroid of a mechanical component. Output needed to drive a numerically controlled lathe or milling machine to shape a part from raw metal can be generated directly from the part model on-screen. And concise material lists can be derived from a complicated assembly drawing simply by invoking a data extraction feature similar to the reporting functions commonly found in database programs.

—Jeff Prossie

Figure 4: These screen shots show how one house plan was broken into layers in the early stages of development. The first layer gives the outline of the walls, the second-layer symbols represent the swinging and sliding doors, and the third layer adds the text that denotes the size and function of each room.



doors, and the third layer adds the text that denotes the size and function of each room.

One of the quickest ways to increase your CADD productivity is to take advantage of macro capabilities the program offers. CADD macros are like those commonly found in spreadsheets and word

processors in that they let you record and play back sequences of keystrokes or pointer movements to eliminate needless manual repetition.

High-end CADD packages such as AutoCAD go even further and offer their own programming languages. *AutoLISP* is a CADD-specific implementation of the

LISP language that lets you customize AutoCAD by building your own program files, which are executed like commands. If you need a capability not already built into AutoCAD—maybe a function to draw a box, or to draw two parallel lines a certain distance apart with a single command—you can create it yourself and make it a part of the package. Working better and faster is working smarter, and working smarter means increasing your productivity.

PORTABILITY One of the problems you're likely to encounter if you deal frequently with CADD is that of transporting files produced by one system to another. Unfortunately, all CADD programs currently on the market use proprietary file formats. You can't, for example, create a drawing file with *Generic CADD* and then read it directly into *Cadkey* or *VersaCAD*. Nor can you go the opposite direction, sending a *Cadkey* or *VersaCAD* file to be interpreted by *Generic CADD*.

The solution is to use what are called "neutral format" files as a vehicle for drawing exchange between systems. The economics behind the idea of neutral files are easily demonstrated. If the vendors of six different CADD programs had to supply translators that would enable them to import drawing files from each of the other five, a total of 30 different translators would have to be written. If a new product came along, chances would be slim that the other vendors would rush to support it. But if all the CADD programs possessed the ability to read and write files in a common neutral format, then each would have an established link with the others. Then each vendor need supply only a single



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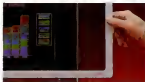
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HELP FILE

Volume 8
Number 3
February 14, 1989

Miscellaneous Statements

BEEP—Beeps the speaker
SYNTAX: BEEP

DATA—Store constants for use by READ statement
SYNTAX: DATA *constant* [*constant*]...
constant = any numeric or string constant

DEF FN—Create a user-defined function
SYNTAX: DEF FN *name* [*variable* [*variable*]...] = *expression*
name = any valid variable name. This name with FN in front of it becomes the function name.
variable = an argument to the function. When the function is called, it is replaced by the corresponding value.
expression = defines function result.

DEF SEG—Define the current segment
SYNTAX: DEF SEG [= *segment*]
segment = a numeric expression from 0 to 65535.
Default BASIC's data segment.

DEF USR—Give location of assembly language subroutine called by USR function
SYNTAX: DEF USR(*n*) = *offset*
n = 0..9. Identifies USR routine. Default 0.

DEFINT—Define variables as integers
SYNTAX: DEFINT *letter* [-*letter*] [*letter* [-*letter*]]...
letter = define variables beginning with this letter as integers by default. Type-declaration characters (% , ! , # , \$) can override this definition.
letter-letter = define variables beginning with this range of letters as integers by default.

DEFSNG—Define variables as single-precision (see DEFINT)

DEFDBL—Define variables as double-precision (see DEFINT)

DEFSTR—Define variables as string (see DEFINT)

DIM—Set dimensions of array variables
SYNTAX: DIM *arrayname* (*subscripts*) [*arrayname* (*subscripts*)]...
arrayname = name for the array
subscripts = comma-separated list of numeric expressions specifying array dimension *maxima*. Minimum for array dimensions is 0 unless changed using OPTION BASE statement. An array can have a maximum of 255 dimensions.

ERASE—Erase arrays and deallocate their RAM
SYNTAX: ERASE *arrayname* [*arrayname*]...
arrayname = name of existing array to erase

KEY—Set or display the soft keys
SYNTAX: KEY ON/OFF/LIST — or — KEY *n*, *string*
ON = first six characters of soft key values displayed on 25th line
OFF = soft key values not displayed. Line 25 does not scroll even with KEY OFF.
LIST = list full 15-character values of soft keys
n = function key number (1..10)
string = string assigned to KEY *n* (up to 15 characters)

LET—Assign value to variable
SYNTAX: [LET] *variable* = *expression*

MID\$—Insert one string into another
SYNTAX: MID\$(*string*, *start* [, *length*]) = *string2*
start = 1..255. Character to begin insertion.
length = 0..255. Number of characters from *string2* to insert. Default all characters in *string2*.

OPTION BASE—Set minimum value for array subscripts
SYNTAX: OPTION BASE *n*
n = 1 or 0. Default 0.

RANDOMIZE—Seed the random number generator
SYNTAX: RANDOMIZE [*number*] — or — RANDOMIZE TIMER
TIMER = seed generator with current time
NOTE: If *number* is omitted, BASIC prompts for a random number seed.

READ—Read values from DATA statements
SYNTAX: READ *variable* [, *variable*]...

REM—Insert nonexecuting comments in program
SYNTAX: REM *string*

RESTORE—Control which DATA statements used by READ
SYNTAX: RESTORE [*line*]
line = line number of a DATA statement. Default first DATA statement in program.

SWAP—Exchange values of two same-type variables
SYNTAX: SWAP *variable1*, *variable2*

—Neil J. Rubenking



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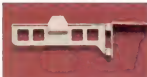
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■ PC LAB NOTES

translator that allows his system to go back and forth between its proprietary format and the agreed-upon neutral format.

There are currently two neutral file formats in widespread use: .DXF and IGES. .DXF and its ramifications have already been discussed in conjunction with *WordPerfect* 5.0. IGES, the acronym for Initial Graphics Exchange Specification, is a more encompassing standard established by the American National Standards Institute for the exchange of 2-D or 3-D drawing files. IGES is almost universally supported by mainframe CADD vendors and enjoys growing support among PC-based CADD vendors.

To transport a drawing file from *Cadkey* to *AutoCAD* using the .DXF format, you would simply call the drawing up in *Cadkey*, save it as a .DXF file, then go into *AutoCAD* and read in the .DXF file. Theoretically, you would see the same drawing in *AutoCAD* as you saw in *Cadkey*. In practice, you will have a certain amount of touching up to do. Regardless of their claims, different CADD vendors support .DXF and IGES transfers to varying degrees. Moreover, there is an inevitable degree of mismatch between the entity or data types in the respective formats. One CADD program may support eight different line types, for instance, while another supports only five. These inconsistencies often result in translation errors. But even if transfers are not fully effective, a 95 percent success rate is better than none at all.

NEW FRONTIERS CADD is largely an outgrowth of advances in the wider field of computer graphics. As technology is further refined and hardware continues down the path toward higher performance for less money, you can soon expect to see PC-based CADD systems that rival what runs today on \$80,000 engineering workstations. The next move will be to true solid modeling, where part geometry is represented as an unambiguous mathematical solid rather than by edges or surfaces. Real-time graphical simulations are not far away, either.

CADD is no longer restricted to use only by scientists and engineers. CADD programs have flowed into the mainstream and are ready to be classed as "commodity items," along with word processors,

spreadsheets, and database programs. The next time you need pictures, think about CADD. And when you think about CADD, think of it as a means to an end, not as a prototypical tool with little or no

application beyond the boundaries of its scientific origins.

Jeff Prossie is a contributing editor of PC Magazine.



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■ UTILITIES ■ MICHAEL J. MEFFORD

SMOOTH SCROLLING MEANS EASY READING



Text browsers usually scroll in whole-line increments, blurring the words you're trying to read. SMOOTH.COM lets you navigate through your files without a jump.

If you've ever tried to read a file by **TYPE**ing it to the screen and toggling between the Pause and another key, you know why text-browsing programs like **BROWSE** (Utilities, March 25, 1986) and **DR** (August 1987) are popular utilities. Yet for *reading* a file, these and other browsing programs share one disadvantage with word processors: their minimum vertical increment is a full screen line. Scrolling a full line at a time is a big enough jump to blur the words you're trying to read. That's what makes **SMOOTH.COM** so desirable.

Among the many untapped treasures of the EGA and VGA is the video adapters' ability to scroll the display smoothly, one scan line at a time. Each full character line actually consists of several scan lines—14 for the EGA and 16 for the VGA. By controlling the scroll rate in increments of successive scan lines instead of full character clumps of 14 or 16 at once, **SMOOTH.COM** creates an effect similar to the one caused by increasing the frame rate in a motion picture. Charlie Chaplin's actions look jerky on the screen because the early silent-movie frame rate of 18 frames per second is not enough to fool the eye into seeing continuous motion. Modern projections of 24 frames per second capture more intermediate steps in the action, and the result is a smooth motion picture.

In addition, **SMOOTH** gives you full navigational control of both scrolling speed and direction. You can also freeze the screen or flip past whole pages at a time, so you don't lose any of the flexibility of other browsing programs.

GETTING SMOOTH The easiest way to obtain a copy of **SMOOTH.COM** is to download it from PC MagNet, as explained in the sidebar "SMOOTH by Modem." **SMOOTH.ASM**, the assembly language source code, and **SMOOTH.BAS**, a BASIC program that will create **SMOOTH.COM** when you run it, are printed here and are also available via PC MagNet.

The syntax for **SMOOTH** is

```
SMOOTH filespec [/W]/[Snn][Cnum]
```

The only required argument for **SMOOTH** is the *filespec*, which is the filename (plus any additional drive and path information required) you wish to process. Once this is supplied, **SMOOTH** will start scrolling the file on-screen. The Up Arrow and Down Arrow keys set the scrolling direction. PgUp and PgDn flip a screenful at a time, and the Home and End keys take you directly to the start or end of the file. Pressing

the Spacebar at any time freezes the screen so you can stop and think. Any subsequent keystroke will restore the scrolling motion. Hitting the Esc key exits **SMOOTH** and returns you to DOS.

You can use the Plus and Minus keys as accelerators to control the scrolling speed. Repeatedly pressing the Minus key (or just holding it down) will slow the scrolling rate until it stops altogether. The Plus key does the opposite, increasing the speed until it becomes equivalent to scrolling a full character line at a time. Alternatively, the scrolling speed can be chosen by pressing one of the number keys. Zero brings **SMOOTH** to a standstill, and 1 through 9 steadily increase the rate.

The three optional switch parameters let you customize **SMOOTH**'s operations without awkward **DEBUG** patches. The /W switch strips the high bit before displaying the text; this is necessary for viewing *WordStar* document files. The /C color switch is followed by a decimal number for the display attribute. The number for the desired color is calculated by the following formula:

```
color = Foreground color + (Background color * 16)
```

You can find the listing of the colors and their numbers in a BASIC manual (under the Color statement) or just experiment until you find a combination you like. If you have a color system and you don't add the color switch, **SMOOTH** uses the default color 23, which is white lettering (7) on a blue background (1).

The /S parameter sets the initial scroll-

■ **SMOOTH** gives you full navigational control of both scrolling speed and direction, and lets you flip past whole pages at a time.

■ UTILITIES

ing speed. The value you enter for *nn* represents twice the number of scan lines that are to be scrolled on every cycle. A speed of 1 means the text is scrolled $\frac{1}{2}$ scan line at a time. (Since there is no such thing as $\frac{1}{2}$ scan line, a speed of 1 is implemented by scrolling 1 scan line every other cycle.) The default speed of 3 translates into $1\frac{1}{2}$ scan lines scrolled per cycle, which is obtained by alternately scrolling one scan line then 2 scan lines on each cycle. The halving of speeds when they're translated into scan scrolling rates effectively doubles the sensitivity of speed control. The actual linear speed corresponding to a given number may vary somewhat with processor speed.

The best way to implement the desired switch options is with a batch file. For example, to read *WordStar* documents, us-

ing yellow characters on a blue background, at the slowest scrolling speed of one, you could make a batch file called *S.BAT*, containing the one line

```
SMOOTH %1 /W /C30 /S1
```

Then, viewing a file with your custom settings is as easy as entering

```
S filename
```

SMOOTH supports any alphanumeric video mode of any row-and-column combination, including the popular 43-line EGA and 50-line VGA modes. There are no restrictions on what kind of file you can view. Browsing a *.COM* or *.EXE* file, of course, will produce a nonsensical display except for embedded text messages. For that matter, viewing any non-ASCII text

file, including word processor documents that include formatting commands, may not yield what you expect. In terms of working, however, there are very few caveats to observe: pop-up TSRs like *SideKick* will not work properly with SMOOTH because SMOOTH manipulates the CRT (cathode-ray tube controller) registers directly. For the same reason, *PrnSc* won't work normally.

HOW SMOOTH WORKS As I indicated previously, the EGA uses 14 scan lines and the VGA uses 16 scan lines for each character line. The EGA and VGA also have a PRS (preset row scan) register, which controls at which scan line of the top character row the display will begin after a vertical retrace (see Figure 1). This register

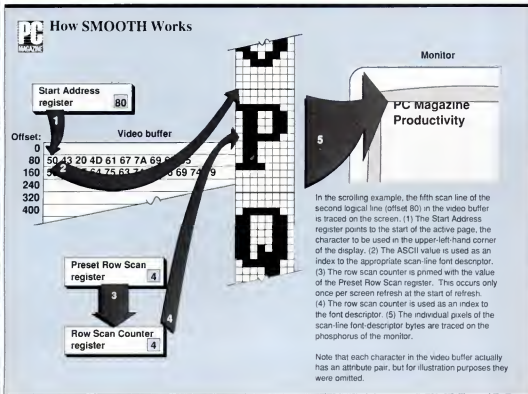


Figure 1: This illustration shows the start of a screen refresh right after a vertical retrace.

(5M) WITH ASM (continued)

— 5 —

```

                                CWP      DIRECTOR,DOWN      ;Are we scrolling opposite of
                                JR         REVERSE_UP      ;page request? If yes, reverse.
                                JC        PAGE_UP          ;If no, is a full page displayed?
                                JRC       PUPD_END        ;If no, ignore.
                                CALL      MOVE_FILE_POINTER ;If yes, move file pointer to top
                                CALL      PAGE_UP          ;of page.
                                JC        CX_PAGE         ;Derivative page length.
                                JR         PARTIAL_PAGE    ;Can we page up a full page?
                                DO        NO_WRITE        ;If no, partial page.
                                DO        NO_WRITE        ;If yes, retrieve last line.
                                CALL      PAGE_UP          ;If yes, move to top of prev. page.
                                JC        WRITE_DOWN        ;If short page, partial.
                                JMF        SCROLL_PUPD_END ;Else, move back to bottom no done.

REVERSE_UP:                   CALL      CX_PAGE         ;If full page continue.
                                JAS       NO_REVERSE     ;Else use partial page.
                                CALL      PARTIAL_PAGE    ;
                                JR         PUPD_END       ;
                                SI        LAST_LINE       ;If already home, ignore.
                                CALL      WRITE_DOWN      ;Else, retrieve last line.
                                JC        NO_WRITE        ;Move up a page.
                                CALL      MOVE_FILE_POINTER ;Write that page.
                                CALL      MOVE_UP         ;Move file pointer back to top.

PUPD_END:                     RET

FUDGE:                         CWP      DIRECTOR,DOWN      ;Are we scrolling opposite of
                                CALL      REM_PAGE        ;page request? If yes, reverse.
                                CALL      REM_PAGE        ;Else, move to next page.

REVERSE_DOWN:                 CALL      MOVE_DOWN        ;Else, move to bottom of page.
                                CALL      REM_PAGE        ;Display next page.
                                CALL      REM_PAGE        ;Move file pointer back to top.

HOME:                          MOV       CURRENT_SCAND,9 ;Move to scan line zero.
                                CWP      DIRECTOR,DOWN      ;Are we scrolling opposite of
                                JR         REVERSE_DOWN   ;page request? If yes, reverse.
                                JC        CX_PAGE         ;Is a full page displayed?
                                CALL      NO_WRITE        ;If no, continue, else ignore.
                                RET

REVERSE_DOWN:                 OR        EP,EP            ;Are we already home?
                                JR         HOME          ;If yes, ignore.
                                SI        LAST_LINE       ;Else, retrieve last line.
                                CALL      REM_PAGE        ;Move up number of lines
                                JC        NO_WRITE        ;currently displayed.
                                CALL      PAGE_UP          ;
                                CALL      WRITE_DOWN      ;Print the first page.
                                CWP      DIRECTOR,DOWN      ;Scrolling down.
                                JRI        HOME_END        ;If no, done.
                                CALL      MOVE_UP         ;Else, move file pointer to top.
                                RET

END_REW:                       MOV       EX,FFFFFH       ;Move down until bottom reached.
                                DIRECTOR,DOWN            ;
                                JRS        DOWN           ;page request. If yes, reverse.
                                DO        NO_WRITE        ;Derivative last line.
                                DO        NO_WRITE        ;If short page and write.
                                JMF        SCROLL_REVERSE ;Check if file pointer correction.

SPACE_BAR:                    JR         AM,1           ;Wait until keyboard ready
                                JI        10             ;
                                JS        SPACE_BAR       ;If space bar, set keyboard.
                                CWP      AM,SPACE        ;
                                JI        SPACE_END       ;
                                JI        SPACE_END       ;
                                JI        SPACE_END       ;
                                RET

SPACE_END:                     RET

;-----
; Function support routines. ;
;-----
PARTIAL_PAGE:                 MOV       CURRENT_SCAND,9 ;Move to scan line zero.
                                SI        9              ;Picture with number of lines
                                JI        10             ;display.
                                JI        10             ;If yes, already home.
                                RET

WRITE_DOWN:                   CALL      CX_PAGE         ;Write a full page plus one
                                JRC       5              ;line to display.
                                CALL      STONE_FLAD,1    ;
                                CALL      WRITE_PAGE      ;
                                JAT

MOVE_UP:                       CALL      CX_PAGE         ;Move up a full page plus one.
                                JRC       5              ;
                                CALL      PAGE_UP         ;
                                MOV       LAST_LINE,SI    ;
                                RET

MOVE_DOWN:                     CALL      CX_PAGE         ;Move down a full page.
                                JRC       5              ;
                                MOV       ST_LAST_LINE   ;
                                MOV       STONE_FLAD,0    ;
                                CALL      WRITE_PAGE      ;
                                RET

NEW_PAGE:                      CALL      CX_PAGE         ;Get page size.
                                JI        10             ;
                                MOV       STONE_FLAD,9    ;
                                CALL      WRITE_PAGE      ;
                                MOV       CX,9           ;Show lines moved.
                                CALL      CX_PAGE         ;Derivative page size.
                                JI        10             ;Derivative page request.
                                JI        10             ;If short page, partial.
                                JI        10             ;Else, move up page plus one.
                                RET

                                CALL      PAGE_UP         ;And write the page.
                                CALL      WRITE_DOWN      ;
                                CALL      CX_FILE_READ    ;
                                JI        NEW_PAGE_END    ;
                                MOV       AM,SCAN_Lineval ;Change scan line to last line.
                                JI        10             ;
                                MOV       CURRENT_SCAND,AM ;
                                RET

SHORT_PAGE:                   MOV       EX,AX           ;Per short files. Move back
                                JI        10             ;the number of lines

```

[illegible]

(SMOOTH ASM continues)

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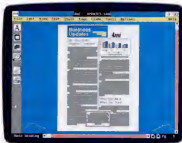
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(SMCCTH)ASM ends

■ UTILITIES

Start Address doing the programming, the window of video memory, or active page, that is used to fill the screen is slowly inched along in video memory, one line at a time. The effect is similar to that of moving a magnifying glass over a newspaper. The text on the newspaper appears to move but the newspaper is stationary. All that is moving is the window to the newspaper.

Using a speed factor other than our one-per-iteration example implements a rollover of the PRS, instead of resetting the PRS to 0. That is, if three scan lines are to be scrolled on each iteration (an *nm* speed of 6), and if adding 3 to the current PRS would exceed the total scan lines by 2, then the PRS is set to 2 and the Start Address registers are incremented by a line. Programming of both the PRS and the Start Address registers can be done during the time it takes for a vertical retrace. This prevents mixing of displayed portions and associated flicker.

I should briefly mention one other pair of CRT registers SMOOTH manipulates: the Cursor Location registers. These registers, like the Address Start registers, are used as a pair to make up the word location in video memory where the cursor is to appear. Since a visible cursor would only be a distraction to SMOOTH, the cursor is programmed to stay one line ahead of the end of the active display page, so it is never seen.

SMOOTH, of course, has to place the data (the contents of the file to be browsed) in the video buffer while all this scrolling is going on. A new text line is added at the bottom of the active page as each line is scrolled off the top and the buffer address start is advanced. Eventually, SMOOTH will run out of the 32K available for EGA and VGA video memory. (Access to additional video memory is possible with some additional register programming, but it doesn't change the fact that video memory is limited and something must be done.)

Once SMOOTH has crept up on the 32K memory limit, the active display portion now is moved by copying the active page to the starting offset (offset 0) of video memory. The problem of flicker does not arise in this case, however, since at this point the active page is at the end of video memory and the destination of the move (the start of video memory) is not currently

being scanned. After the move, the Address Start registers are reset to 0 to reflect the move and SMOOTH can again start its inching line-by-line cycle. The page copying does have one small side effect, however. As I mentioned above, moving memory takes a lot longer relative to the few register-programming instructions. Thus there is a small but noticeable pause in the smooth scrolling at this point. Since this happens only after approximately eight screen pages (32K divided by 4,000 bytes per page), the momentary slowdown is infrequent and quite tolerable. (For convenience' sake SMOOTH actually uses 30K as the top of video memory, a little

■ SMOOTH adds lines to one end or the other of the video buffer's active page, depending on the direction in which lines are scrolled out of range.

less than eight screen pages.)

So far I've been talking about scrolling forward or upward. In the first analysis, scrolling backward or downward is a simple matter of subtracting instead of adding the speed factor. The bottom character row is scrolled off the screen and the new line is added at the top of the active display page instead of the end.

As we have seen, SMOOTH adds lines to one end or the other of the video buffer's active page, depending on the direction in which lines are scrolled out of range. The lines that are added are formatted according to a couple of simple rules. Only the tab character and carriage return are treated as control characters. Tabs (ASCII character 9) are expanded into spaces up to the next column that is a multiple of 8. Carriage returns (ASCII 13) are treated as a carriage-return line-feed pair, causing a move to the beginning of the next line after the current line is padded to its right with spaces. Any line feeds are ignored. All

other characters, including the remaining control characters, are displayed as their ASCII equivalents.

THE FILE BUFFER SMOOTH has to manage two interdependent buffers asynchronously. One is the video buffer I've discussed above. The characters used to format and fill the video buffer come ultimately, of course, from the disk file named on the command line. Rather than accepting the inefficiency of reading from the disk one character at a time, however, a block of up to 30K is read and stored in a section of memory that I'll call a file buffer. The file buffer is used to feed the video buffer. Life would be easy for SMOOTH if scrolling were limited to the forward direction and if valid file sizes were limited to the available RAM. But SMOOTH has to be able to scroll bidirectionally and to be able to handle large files. These capacities present difficulties similar to those that restrict many word processors to files that will fit in memory at any one time.

To understand the complexities, let's look first at how easy it is to scroll forward. First a block of 30K is read from the disk file and buffered in memory. Then, as a line is needed to scroll on-screen, it is fetched from the file buffer, one character at a time. It is formatted on the fly and then placed in the video buffer. When the end of the 30K file buffer is exhausted, the next 30K of the file is read and the scrolling continues. The file buffer and video buffer are asynchronous because of the tab and carriage-return formatting that occurs in the latter.

Now suppose the file buffer contains the following:

```
This is the first line.<CR><LF>
This is the second line.<CR><LF>
```

The characters in the first line are read and placed in the video buffer until the first carriage return is encountered. The actual carriage return is discarded, the balance of the line is filled with spaces, and the line feed is ignored. Now, the file-buffer pointer is at the start of the second line poised for the next scroll. Assuming the file pointer is still there, let's now see what happens when we attempt to scroll backward.

We now need to read from the file buffer backward so that the previous line can

SMOOTH BY MODEM

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Michael J. Mefford

1989 No. 3 (Utilities)

Purpose:

An EGA or VGA text-browsing utility that makes reading from the screen easier by providing smooth scrolling in either direction at user-selectable speeds.

Format:

SMOOTH filespec [/W] [/Snn] [Cmm]

Remarks:

The *filespec* entered with SMOOTH is a filename plus any required drive and path information. The optional /W switch strips the "high bit" from WordStar document files. The optional /Snn switch sets the scrolling speed, where *nn* is a decimal number that represents twice the number of pixel rows to be scanned on each screen-refresh cycle. The default value for *nn* is 3. For comparison, the DOS TYPE command used with an EGA (14 pixel rows per character) would have an *nn* of 28. The optional /Cmm sets the foreground and background colors according to

$mmm = \text{foreground color} + (\text{background color} * 16)$

The foreground and background color numbers are given in the BASIC manual in the section on the Color statement. The default is 23 (white letters on a blue background).

The Up Arrow and Down Arrow keys set the scrolling direction, and PgUp and PgDn flip a screen page. The Home and End keys go directly to the top and bottom of the file. Pressing the Spacebar (or the numeral 0) freezes the screen, which can be restarted by pressing any key. Hitting Esc cancels SMOOTH and returns to DOS. Pressing the Plus and Minus keys speeds up or slows down the scroll rate, as does pressing the number keys.

Note: Since SMOOTH manipulates the Cathode Ray Tube Controller registers directly, it is incompatible with the operation of SideKick and Print Screen.

Available for downloading from PC MagNet (see the sidebar "SMOOTH by Modem"), SMOOTH.COM is already compiled and ready to run. SMOOTH.BAS will automatically create SMOOTH.COM when you run it once in BASIC. Creating SMOOTH.COM from the SMOOTH.ASM source code requires the use of a macro assembler (IBM or Microsoft, Version 2 or later) and the following commands:

```
MASM SMOOTH;  
LINK SMOOTH;  
EXE2BIN SMOOTH SMOOTH.COM;
```

■ UTILITIES

be added to the video buffer and scrolled from its top row of pixels back onto the screen. The first character encountered is the line feed at the end of the first line. Line feeds are ignored. The next character is the carriage return, which indicates an end of line. Moving backward in the file, the first sentence's period now needs to be placed in the video buffer but *not* in the last column. The first line is less than a full 80 columns in length, so the period belongs somewhere in the middle. But where? Formatting rules work from left to right, not right to left.

What we really need to know to move backward is where the *start* of the line is so that we can then format the video buffer starting from the left column. (Of course, for the first few pages, the previous lines will still exist in the video buffer and do not need to be refetched and reformatted. Remember that when scrolling reaches the end of the video buffer, the active page is

moved to the video-buffer start, which writes over previous pages.)

BACKWARD SCROLLING To solve the backward-scroll problem, SMOOTH constructs an index of all the line starts as they are discovered when scrolling forward. The index does not consist of the actual file-buffer line-start addresses, as you might expect, but rather of the difference in bytes between the lines. I'll explain the reason for this in a moment. In the previous example, the index for the first line would be 25, the number of file-buffer bytes that it took to construct the video-buffer line. SMOOTH dedicates an entire 64K data segment for the indexes. Each index takes up a word of memory (to handle the extra-long lines the EGA and VGA are capable of displaying). This, in turn, means allowing for a maximum of 32K worth of lines, enough to handle text files of virtually any size.

The actual indexing method used in SMOOTH is a modification of the same technique used in DR. Because of memory limitations, DR was restricted to managing an index for the start of each screen page instead of one for each individual line. Since SMOOTH is less memory-bound and needs to access lines faster to keep things smooth, it keeps an index for every line.

SPLIT BUFFER I also imported into SMOOTH the split file buffer that is used in DR. I must give the credit for the idea of the split buffer to Charles Petzold, who used it in his BROWSE program. A split buffer is maintained to keep file accesses to a minimum. The file buffer is divided into two contiguous 30K halves that are stored between the end of SMOOTH's code and the stack that is at the end of the 64K code-and-data segment. The first read from disk is stored in the second half of the



total 60K that is reserved for the file buffer.

In forward scrolling, lines are added to the video buffer from the file buffer. In the process, if the end of the second half of the file buffer is reached, the entire second half is copied to the first half, and the next 30K is read from disk into the buffer's second half. After the read, the file-buffer pointer is at the start of the second half, which is exactly in the middle of the entire 60K buffer.

If scrolling is reversed at this point, the file-buffer pointer is able to dip into the first half of the buffer instead of having to reread that data. In other words, the scrolling can proceed in either direction for a whole 30K without another disk access. Fewer disk accesses mean fewer pauses, which enables SMOOTH to live up to its name.

In backward scrolling, the start of the file buffer will eventually be reached. This time the first half of the buffer is copied

into the second, the previous 30K of disk file is read into the first half of the buffer, and the file buffer pointer is again placed exactly in the middle. Because of this, we

■ Scrolling can proceed in either direction for a whole 30K without another disk access, meaning fewer pauses.

are again ready to move in either direction without further need for a disk access for a while.

It's because of the split buffer that the indexes are byte differences between lines

rather than the actual file-buffer pointer addresses. Depending on the direction of scrolling, the same data can be in either the first half or the second half. By keeping track of the relative differences between lines, all that must be adjusted in a block move is the current file-buffer pointer, by 30K in the direction of the move. Since all the line start addresses are relative, they are effectively adjusted as well.

As you can see, the actual concept of scrolling one scan line at a time is a relatively simple one. SMOOTH only has to program two CRTC registers, and the video hardware takes care of the display. It's when all the features such as paging, backward scrolling, and large file handling are added that SMOOTH has to perform a few contortions to keep things rolling along smoothly.

Michael J. Mefford is a contributing editor of PC Magazine.

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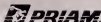
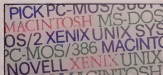
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SPEAKING THE LANGUAGE OF THE PM API, PART 2



Microsoft's introduction of new data types for those normally used in C has raised many programmers' hackles, but portability to the 80386 and beyond demands them.

Question: What word is found very frequently in almost every C program but found only rarely in OS/2 Presentation Manager programs? Answer: The word *int*.

Programmers who write for the Presentation Manager often use new data types defined in the PM header files rather than employing the normal C data types such as *short*, *int*, and *long*. This is true particularly for variables that are passed through the API as parameters to the PM functions, for values returned from the functions, and for storing data encoded in PM messages.

The definition of these new data types is perhaps the most controversial aspect of the Presentation Manager header files. On PC MagNet, I've recently heard programmers use the terms "arcane," "excessive," and "baroque" to describe what Microsoft has done with the header files.

The new data types are used throughout Microsoft's OS/2 documentation. You simply have to learn them before you can intelligently approach the function-call documentation. Even the OS/2 kernel functions are documented using the new data types. If you're programming for the OS/2 kernel in assembly language, you can't read the documentation unless you can translate the new data types into the more familiar WORDs and DWORDs.

More important, however, is that once you realize why these new data types have been defined in the header files, you'll want to use them. As you know, an 80386 version of OS/2 is on the way. One important purpose of the new data types is to ease

the conversion of PM programs from the 80286 to the 80386 (and beyond).

TYPEDEFS AND DEFINES The new data types are written in uppercase and without underscores. This differentiates them from the uppercase identifiers with underscores that define constants used as function parameters, as I discussed in the previous issue.

Most of the basic data types are defined in the OS2DEF.H header file. For some of these, the C #define statement defines the new data type like this:

```
#define SHORT short
```

Here, the identifier *SHORT* is a synonym for the C data type *short*. In other cases, the header files use a typedef statement, like this:

```
typedef unsigned short USHORT ;
```

USHORT is a new data type that is the

same as a C unsigned short type. You use *SHORT* and *USHORT* to define variables in your program the same way you use *short* and *unsigned short*.

Figure 1 shows the basic OS/2 data types and the corresponding C data types. As you can see, they're really quite straightforward and easy to learn. You can use either *UCHAR* or *BYTE* for an unsigned char. The *BOOL* data type is generally used for a variable that is either 1 (*TRUE*) or 0 (*FALSE*). *OS2DEF.H* also defines the constants *TRUE* and *FALSE*.

Although *OS2DEF.H* defines *INT* and *UINT* for the C *int* and unsigned *int* types, these are used only occasionally in the definition of OS/2 function parameters and structure fields. The *int*—so common in normal C programs—is the least common data type in the Presentation Manager. We'll shortly see why.

STRUCTURE DEFINITIONS Many PM function calls require a pointer to a structure as one of the parameters. The header files also define these structures. For example, here's the definition of the *POINTL* structure that you use to specify a coordinate point when calling *GPI* (Graphics Programming Interface) functions:

```
typedef struct _POINTL
{
    LONG x ;
    LONG y ;
}
POINTL ;
```

This structure contains two *LONG* fields, *x* and *y*. The structure is given both a tag name (*_POINTL*) and a typedef name

■ One important purpose of the new data types is to ease the conversion of PM programs from the 80286 to the 80386 (and beyond).

■ ENVIRONMENTS

OS/2 and
C Data Types

OS/2 data type	C data type	Current bit length
CHAR	char	8
UCHAR	unsigned char	8
BYTE	unsigned char	8
SHORT	short	16
USHORT	unsigned short	16
BOOL	unsigned short	16
INT	int	16
UINT	unsigned int	16
LONG	long	32
ULONG	unsigned long	32

Figure 1: The basic C data types as redefined in the OS/2 header files.

(POINTL). To define a structure variable in your program, you can use either

```
struct _POINTL ptl ;
```

or

```
POINTL ptl ;
```

The second form is more common. In either case, the ptl variable is a structure of type POINTL. In your program, you refer to ptl.x and ptl.y to reference the structure fields. You can define an array of POINTL structures like this:

```
POINTL aptl[32] ;
```

Here's a somewhat longer structure, the MENUITEM structure, which contains all the information associated with a particular item on a program's menu:

```
typedef structure _MENUITEM
{
    SHORT iPosition ;
    USHORT afStyle ;
    USHORT afAttribute ;
    USHORT id ;
    HWND hwndSubMenu ;
    ULONG hItem ;
}
MENUITEM ;
```

I'll discuss the HWND data type shortly. As you can see, the other fields are defined using the basic data types SHORT, USHORT, and ULONG. No ints.

Let's try to figure out why the C programmer's favorite data type has been banished to obscurity in the Presentation Manager.

MOVING TO THE 80386 One of the most common complaints about OS/2 is that it was written for yesterday's technology (the 80286 microprocessor) rather than for today's hot machine, the 80386. The 80386 supports 32-bit registers and true 32-bit addressing, which finally frees us from the 64K segment limit imposed by all the Intel microprocessors from the 8088 to the 80286.

Microsoft has publicly stated that an 80386 version of OS/2 is coming and that a software development kit for programmers will be available in the first half of this year. The 80386 version of OS/2 will, of course, continue to run programs written for the 80286 version, and it will also use the 80386's virtual 86 mode to multitask DOS programs.

At the very least, converting a PM program written for the 80286 API to the new 80386 API will require that the program be recompiled. But often such a port requires some changes to the source code as well. It's certainly not too early to start designing your PM programs for as easy a port as possible. One of the primary purposes of header files (both in normal C programming and in Presentation Manager programming) is to store machine-dependent details. Proper use of header files allows a C program to be more easily ported to other operating systems and machines.

In the original design of C, the size of char, short, int, and long variables is "implementation-dependent." The int is supposed to be the machine's register size, but the only guarantee about the others is that the variable sizes are related like this:

```
char <= short <= int <= long
```

Under the ANSI C standard, a char must be at least 8 bits, a short (and therefore an int) must be at least 16 bits, and a long must be at least 32 bits. In the current version of Microsoft C (and most C compilers for the 8088 through 80286), the data types are the minimum lengths: a char is 8 bits, shorts and ints are 16 bits, and the long is 32 bits.

For a C compiler designed to create programs for an 80386 operating system, however, the size of an int should be 32 bits, for that is the size of the 80386 registers. The short can remain at 16 bits. (It's not quite clear what will happen to the long. It could remain at 32 bits or be promoted to 64 bits.)

The int is not the only thing that gets a promotion from 16 bits to 32 bits. The 80286 uses a 16-bit aligned stack. When a function parameter is defined as a char, the compiler must generate code that expands the variable to 16 bits before pushing it onto the stack. Programs designed for the 80386 use a 32-bit aligned stack. Thus, when a function parameter is either a char or a short, the compiler must expand the variable to 32 bits before pushing it onto the stack.

The 80386 version of OS/2 will run programs written for the 80286 version and new programs written for the 80386 version. One problem that the operating system must deal with involves the different stack alignment used by these two programs. The solution will probably involve separate entry points to the dynamic link library functions. (This technique is discussed in Chapter 8 of the Intel 80386 System Software Writer's Guide.)

But the different stack alignment is not the worst problem, since it can be taken care of within the operating system. A more serious problem involves the OS/2 and Presentation Manager data structures, such as the MENUITEM structure shown. PM functions often require pointers to these structures as parameters. Pointers to structures are passed around quite a bit within the Presentation Manager, from program to operating system, from operating system to program, and among programs themselves.

Any structure that contains an int field would change size between the 80286 and 80386 versions of OS/2. That is a problem, and it's one reason why short (or rather SHORT) fields are used instead. The short remains at 16 bits in the 80386 version, so the size of the structure remains the same.

What happens if a long is increased to 48 or 64 bits in the 80386 C compiler? Doesn't that mess up all the structures anyway, along with the functions whose pa-

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■ ENVIRONMENTS

rameters are defined as LONGs or ULONGs? Not at all. In that case, the header files for the 80386 version of OS/2 can simply define LONG and ULONG a little differently:

```
#define LONG int
typedef unsigned int ULONG;
```

In this way a long may be greater than 32 bits, but a LONG and ULONG will remain 32 bits. Now you see why it's best to use the new data types rather than the C data types.

FAR AND PASCAL The first two definitions in OS2DEF.H are

```
#define PASCAL pascal
#define FAR far
```

You're probably familiar with the far keyword recognized by many C compilers for the PC. The Intel microprocessors from the 8088 to the 80286 have a segmented memory architecture and differentiate between near pointers (which use only a 16-bit offset address within a default data segment) and far pointers (which have both a 16-bit segment address and 16-bit offset address).

To accommodate this segmented architecture, C compilers often allow several memory models: small (one code and one data segment), medium (multiple code segments), compact (multiple data segments) and large (multiple code and data segments). The far keyword lets programmers use far pointers to data in small or medium model programs and far pointers (and far calls) to code in small or compact model programs.

The keyword pascal can be used in C programs to define a function that uses the Pascal calling sequence. When a Pascal function is called, the parameters are pushed on the stack from left to right (rather than from right to left, as is normal in C). The function adjusts the stack back to normal before it returns control to the function caller.

All the OS/2 functions require far calls and use the Pascal calling sequence. The word APIENTRY is defined in OS2DEF.H as a synonym for far pascal:

```
#define APIENTRY pascal far
```

The complete set of OS/2 functions are de-

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fined as APIENTRY functions.

Similarly, window procedures in Presentation Manager functions must also be defined as far functions with the Pascal calling sequence. Another identifier for this purpose is defined in the same way as APIENTRY:

```
#define EXPENTRY pascal far
```

(EXPENTRY stands for "exported entry point": window procedures must be exported so that they can be called from outside the program.)

Why are the FAR, PASCAL, APIENTRY, and EXPENTRY identifiers defined in the header files? Why not just use far and pascal instead?

One of IBM's goals is to port the Presentation Manager to its micros and mainframes. These machines have quite different memory architectures from that of the PC. The identifiers help programmers keep the keywords far and pascal out of their code. The FAR, PASCAL, APIENTRY, and EXPENTRY identifiers can be defined differently in header files for other environments, as appropriate for the particular machine and C compiler.

Pointer Types Often a parameter to a Presentation Manager function is a pointer to a variable. The function uses this pointer to store something in the variable. Because the program making the function call and the dynamic link library that contains the function have different data segments, this must be a far pointer, which contains both a segment and an offset.

The OS2DEF.H header file defines new data types that are far pointers to the basic data types like this:

```
typedef CHAR FAR *PCHAR ;
```

This defines PCHAR as a far pointer to a CHAR. In your program you can define a variable that is a far pointer to CHAR like this:

```
PCHAR p ;
```

Similarly, OS2DEF.H defines PCHAR, PBYTE, PSHORT, PUSHORT, PBOOL, PLONG, PULONG.

These pointer data types also help to keep the words far or FAR out of your programs when you compile for small or medium model. Let's look at an example.

Suppose you need a pointer to an array of 500 bytes for use within your program. You might allocate such a pointer using the C malloc function

```
p = malloc (500) ;
```

and later free the memory by calling free:

```
free (p) ;
```

In this case you would define p like this:

```
CHAR *p ;
```

This gives you a pointer that is appropriate for the particular memory model you use. It is a near pointer in small and medium model programs and a far pointer in compact and large model programs. That is the same type of pointer that malloc returns and that you pass as a parameter to free.

However, suppose a Presentation Manager message passes your program a pointer to a character array. This will be a far pointer. To store this pointer, you need a variable that is defined as a far pointer to a CHAR. Rather than define it like this:

```
CHAR FAR *p ;
```

you can use the PCHAR data type:

```
PCHAR p ;
```

This is a far pointer regardless of the memory model, but the definition doesn't require use of the word FAR or far.

When compiling for compact or large model, the two definitions

```
CHAR *p ;
```

and

```
PCHAR p ;
```

are equivalent. In an environment that doesn't have a segmented memory architecture, the PCHAR type would simply be defined in the header files without FAR:

```
CHAR *p ;
```

A few other far pointer data types are defined in OS2DEF.H: PVOID is a generic far pointer, and PSZ and PCH are the same as PCHAR. (PSZ is often used for a pointer to a string terminated with a zero.)

For every structure definition, the header files also define a data type that is a far pointer to the structure. The name of this data type is the structure name pref-

aced with a P. For example, here's how PMENUTITEM is defined:

```
typedef MENUTITEM FAR *PMENUTITEM ;
```

The data type PMENUTITEM is a far pointer to a structure of type MENUTITEM. You can define a far pointer to a MENUTITEM structure thus:

```
PMENUTITEM pmi ;
```

Or, you can define a pointer to a MENUTITEM structure appropriate for the memory model of your program like this:

```
MENUTITEM *pmi ;
```

HANDLES AND OTHERS In the last issue, I discussed *handles*, numbers that refer to PM objects. Each type of handle in OS/2 and the PM has its own data type. Some of the more common handles are shown in Figure 2. If you need a variable to store a window handle for your menu window, you define it like this:

```
HWND hwndMenu ;
```

Other data types defined in the header files are SEL (a selector), PID (process ID),


 PM Handles and Objects	
Handle data type	Object
HAB	Anchor block
HBITMAP	Bitmap
HFILE	Open file
HMF	Metafile
HMODULE	Module (dynamic link library file)
HMQ	Message queue
HPIPE	Named pipe
HPS	Presentation space
HPTR	Mouse pointer
HRGN	Region (used in GDI)
HSEM	System semaphore
HSWITCH	Task manager switch entry
HVPS	VIO presentation space
HWND	Window

Figure 2: Some common handle data types and the objects to which they refer.

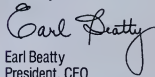
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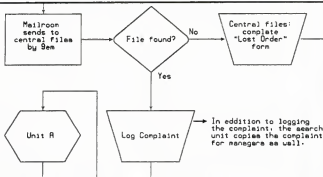
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■ ENVIRONMENTS

TID (thread ID), COLOR (a 32-bit red/green/blue color), ATOM (a number that represents a character string), FIXED (a 32-bit value interpreted as a 16-bit integer and 16-bit fraction), MPARAM (a message parameter to a window procedure), and MRESULT (a message result from a window procedure). The header files also define far pointers to all the following data types: PSEL, PPID, PTID, PCOLOR, PATOM, PFXED, PMPARAM, and PMRESULT.

WHAT ABOUT 80386 POINTERS? In the 8088 through 80286 microprocessors, a far pointer is 32 bits—16 bits for the segment and 16 bits for the offset. Under the 80386, the size of a segment increases dramatically (by a factor of 64K). An 80386 far pointer has a 16-bit segment and a 32-bit offset, a total of 48 bits.

What happens to those structures that contain fields defined as far pointers? Won't the size of the structure increase as we move from the 80286 to the 80386?

Well, maybe not. There are actually a

■ The 80386 allows an operating system to use a flat address space for some programs and a segmented model for others.

couple of different ways to implement an 80386 operating system. Those of us who have been programming for the IBM PC for much of this decade have become so accustomed to segments and offsets that segmented architecture seems like the natural order of the world.

But it's possible that IBM and Microsoft may decide to abandon segmented architecture in the 80386 version of OS/2 and to adopt a flat 32-bit address space with one big segment for the program's code and data. The 80386 allows an operating system to use a flat address space for some programs and a segmented model for others. Programs written for the 80286

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■ ENVIRONMENTS

version of OS/2 would continue to use segmented addressing. In this case, far pointers remain at 32 bits and the size of the Presentation Manager structures remains the same.

FUNCTION DECLARATIONS I mentioned at the outset that all the OS/2 functions are documented in terms of the new data types and declared in the Presentation Manager header files in the same way.

This is why it's necessary for you to learn the new data types before attempting to decode these functions.

But now we're ready to look at a few real function declarations. Here's a function I mentioned a few times in the previous issue:

```
BOOL APIENTRY GpiSetColor (HPS, ULONG);
```

Like all of the other OS/2 functions, this is an APIENTRY function—it requires a far call and uses the Pascal calling sequence. The first parameter is a handle to a presentation space; the second parameter is an unsigned long (which happens to specify the color). The function returns a BOOL, which is actually an unsigned short.

The GpiLine function takes a handle to a presentation space and a far pointer to a POINTL structure:

```
ULONG APIENTRY GpiLine (HPS, PPOINTL);
```

The function returns a ULONG (unsigned long).

Here's a function with nine parameters, which is called from almost every Presentation Manager program:

```
HWND APIENTRY WinCreateWindow (HWND,
                                ULONG, ULONG,
                                PSZ, PSZ,
                                HMODULE, USHORT,
                                HWND);
```

The first parameter is an HWND (handle to a window) and the last parameter is a far pointer to an HWND. The function also returns an HWND. The other parameters are two ULONGs, one far pointer to a ULONG, two far pointers to zero-terminated strings (PSZ), a handle to a dynamic link library module (HMODULE), and a USHORT.

AND MORE TO COME I have been discussing how the language of the Presentation Manager API is defined within the PM header files. We have seen that included in the header files are definitions of the new data types, structure definitions, definitions of identifiers for passing constants to functions, and the function declarations themselves.

This certainly covers the bulk of the header files, but there is still more. In next issue's Environments column I will discuss a few macros, specifically those that help you work with the Presentation Manager messages.

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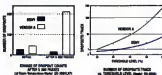
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COMPARING DOS AND OS/2 FILE SYSTEMS



The OS/2 equivalents of QFN.C and QFN.ASM conclude the Power Programming Library updates; a hard look at the limitations of the FAT file system yields insights into the future.

Much carping and not a little criticism has been directed at DOS's so-called FAT (file allocation table) file system lately. In the early days of MS-DOS, the superiority of the FAT file system over its historical predecessor (the CP/M file system) was so glaringly obvious that few programmers were inclined to complain. At that time, too, few users knew of anything better. But, as fixed disks have grown larger and users familiar with more-sophisticated file systems on workstations and minicomputers have come into the microcomputer world, the Panglossian attitude toward the FAT file system has begun to fade.

The gripes about the DOS file system focus on

- the 8- and 3-character limitations on filenames and extensions;
- the 64-character limit on paths;
- file access performance on large fixed disks;
- the tendency of files to become fragmented (to be assigned to disk sectors that are not adjacent, which slows file access);
- the limited amount of information maintained in the disk directory; and
- the infamous 32MB volume limit.

The adventurous group of early OS/2 users and software developers are the most recent addition to the peanut gallery of FAT critics. On one hand, these people are relieved that OS/2 can read and write disks formatted by DOS, making moving files between the two environments effortless. On the other hand, they had apparently hoped (in defiance of common sense) that OS/2 could provide this media compatibil-

ity and simultaneously offer a dramatically better file system.

Thus the FAT file system has become the file system that people love to hate. Before jumping on the bandwagon though, let's take a quick look at file system terminology in general, at the FAT file system's classic limitations and the reasons for them in particular, and at some possibilities for the future.

FILE SYSTEM TERMINOLOGY

"File system" is a nasty, overloaded computer term that can have two completely different meanings. When used in connection with a volume of storage, such as a floppy disk, "file system" refers to the interdependent tables, control areas, and storage areas written on the disk. Taken together, the various elements of a file system define the locations of all files, their contents, and the disk's free space.

As shown in Figure 1, the file system on a DOS disk is made up of the boot sector, the root directory, the file storage area, and the file allocation table, which describes the usage of each allocation unit (cluster) in the file storage area. The file storage area also contains all of the directories other than the root directory. These various areas are initialized by the FORMAT program, and the boot sector contains a table called the BIOS Parameter Block (BPB), which completely describes the disk's characteristics (heads, tracks, sectors per track, sectors in the root directory, and so on).

When used in connection with an operating system, the term "file system" refers

to those internal routines that translate application program requests to manipulate files into appropriate directives to the system's disk device driver. The driver is the module that issues the actual hardware-dependent commands to the disk itself. In both DOS and OS/2, the file system con-

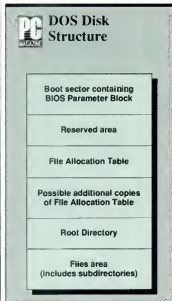


Figure 1: These areas are initialized by the FORMAT program. The boot sector contains a table called the BIOS Parameter Block (BPB), which completely describes the disk's characteristics.

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verts application program file function calls into requests for the transfer of logical disk sectors. The file system then uses the information it finds on the disk in the boot sector, FAT, and directories, as illustrated in Figure 2. The driver, in turn, converts logical sector numbers into physical unit, head, cylinder, and track addresses.

FAT FILE SYSTEM PROBLEMS

Many of the limitations of the FAT file system have their origins in other systems. When Tim Paterson was writing 86-DOS (which later evolved into DOS 1.0), he adapted the file allocation table concept from Microsoft's standalone BASIC,

which was the first high-level language to run on the famous Altair microcomputer. The use of a centralized table in which each entry represents a disk allocation unit and the entries are chained together to represent files—the FAT—was ideal for floppy disks. In a floppy disk system the number of allocation units was small enough that the entire FAT could be kept in memory at all times.

As multiple drive systems and large fixed disks have become common, however, the FAT design has become an impediment to good file-system performance. Since each FAT can be quite large, it's simply not practical to keep the entire FAT for each drive resident in memory. The memory is needed for the execution of application programs, instead. Consequently, since the operating system must also read in FAT sectors in order to locate the file's data, successive file accesses often require time-consuming disk head movements—even when the data in the file itself is stored in contiguous sectors.

Moreover, when a file is being created or extended, the FAT must be searched sequentially for a free slot to be assigned to each chunk of data as it is written. Since there is no guarantee that free slots will be well localized, performance is degraded both when the file is written and when it is accessed later. Pieces of the file are likely to be scattered all over the disk.

The 8-character limit on DOS filenames and the 3-character limit on extensions descends directly from Digital Research's CP/M operating system for 8080- and Z-80-based microcomputers. Paterson wanted to make it as easy as possible to port existing CP/M application programs to 86-DOS, so he cloned the file control blocks (FCBs) used in CP/M to open, create, read, write, and delete files. The FCBs have fixed-length fields for filenames and extensions, which were propagated by Paterson into the format of disk directory entries. Even though most DOS programs today use the more-powerful "handle" file functions (introduced in MS-DOS, Version 2.0) instead of FCBs, the 8-plus-3 limit is still with us because of the structure of disk directories.

Little is known about the origin of the 64-character limit on pathnames. This limit appeared in DOS 2.0 (the first DOS ver-

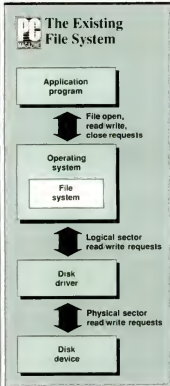


Figure 2: The handling of a disk access request demonstrates the relationship between application program, the operating system kernel (with its embedded file system module), the disk driver, and the physical disk device.

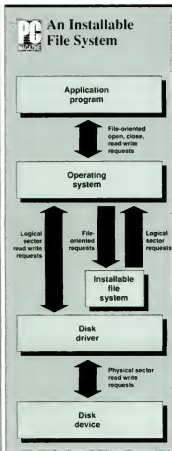


Figure 3: A hypothetical relationship between the application program, the operating system kernel, an installable file system, the disk driver, and the physical disk device.

sion to support a hierarchical directory structure) and has remained unchanged in subsequent versions. The number appears to be completely arbitrary, and was probably one of those implementation decisions that "seemed reasonable at the time."

That old bugaboo, the 32MB limit on volume sizes, has a very clear and simple basis, however. The file system in the DOS kernel issues its requests for logical sectors to the disk driver by passing the

driver a pointer to an information structure called a *request packet*. The request packet field that holds the sector number is 16 bits long, which allows 65,536 sectors to be identified: 0 through 65,535. 65,536 times 512 bytes (the standard sector size in IBM-compatible systems) is 32MB.

In Compaq DOS 3.31, and now in IBM and Microsoft DOS 4.0, the definition of many internal disk-related tables and structures, the BIOS Parameter Block, and the disk driver read/write request packets have been changed to support 32-bit sector numbers. DOS 4.0 can theoretically, therefore, support volumes as large as 2 gigabytes. The new limiting factor is the 32-bit file pointer used in the system file table and by interrupt 21h, function 42h.

FUTURE FILE SYSTEMS Versions 1.0 and 1.1 of OS/2 use a FAT file system just like that of DOS. OS/2 Version 1.1 supports volumes larger than 32MB in the same manner as DOS 4.0. In response to the other criticisms of FAT file systems, Microsoft and IBM have stated that OS/2 will be upgraded to support something called an "installable file system," but they have revealed few details. Let's try to imagine what they have in mind.

As far as the operating system goes, we can easily predict that the file-system logic will simply be segregated into a separate, replaceable file. This would be loaded into memory as the result of some CONFIG.SYS file directive, much like a device driver. The operating system kernel would

pass "logical" file manipulation requests (in terms of opens, closes, reads, writes, and so forth) to the file system module, and the file system module would request disk sector reads and writes from the disk driver via the kernel. Figure 3 illustrates such a hypothetical future system.

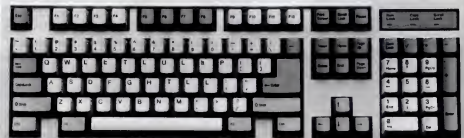
Once some such mechanism is in place, there is no reason why multiple file-system modules can't be loaded at once, each assigned to a different logical drive. That will allow an OS/2 program to read or write disks in any imaginable format. The operating system needs a "default" file system so that it can boot itself off the disk, presumably, the FAT file system.

"Externalization" of the file system from the operating system kernel in this

[illegible]

Figure 4: The OS/2 version of OFN.ASM, which qualifies filenames. The DOS version appeared in the July 1988 Power Programming column.

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ready has network and CD-ROM extensions under development, we can deduce that OS/2 support for installable file systems is in the bag. The transition from supporting one installable file system to supporting as many as you like should be a much simpler step than the original, major step that was taken in DOS 3.1—going from no installable file system at all to one installable file system. It would be nice to think that Microsoft and IBM will see fit to generalize and publish the installable-file-system hooks in DOS too, so that the huge installed base of DOS machines will not be denied the advantages of new, superior file systems.

Microsoft has also announced that it not only plans to allow for installable file systems but will actually develop a new file system (operating system module and disk format) that will eliminate many of the FAT file system restrictions. Gordon Letwin (the author of *Inside OS/2* and one of OS/2's designers) is said to be spearheading the effort. I can only hope that Letwin, who is a Unix devotee from way back, won't incorporate too many Unix concepts into this wonderful new file system. Unix file systems are notoriously fragile—so fragile that Unix automatically runs a file system fixup program called "fsck" each time it is booted. In Unix environments, total trashing of the file system requiring a complete reload from backups is commonplace; Unix fans take this for granted and forget to mention it when they are explaining how much better Unix is than DOS or OS/2.

In any event, what can we learn about the apparently forthcoming "improved" file system by examining the existing OS/2 file function calls? It's interesting that many of the OS/2 functions can return file information that is not present in FAT file-system directories. For example, the OS/2 functions that search for matching file-names provide for the return of no fewer than three sets of times and dates for each file: the time and date of file creation, of the last write, and of the last access. They also allow for a 16-bit file attribute (FAT file systems directories contain 8-bit attributes), and for the return of a separate file allocation size and current file size. The OS/2 function that creates a file allows the program to specify an initial allocation,

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and its documentation states that "when possible," OS/2 will pre-allocate the space to minimize access times.

With regard to naming limitations, there is nothing "wired into" OS/2 function calls that requires a path, filename, or extension to have any specific length. If a program provides a path, name, or extension that is too long for the type of file system being accessed, OS/2 returns an error; no name is ever silently truncated, as happens in DOS. If an OS/2 program is obtaining a pathname (such as the "current directory") from the operating system and the buffer it provides is too small, OS/2 will return an error along with the length required for the buffer.

OS/2 also has distinct function calls that get, add, or change the volume label. This is very unlike current versions of DOS, which force you to use variants of the file search, create, and rename functions. That seems to indicate that future file systems will place the volume label somewhere other than in the root directory, and may be capable of associating other information with the label (perhaps access rights and passwords). DOS 4.0 may be trying to tell us something here; it puts a copy of the volume label in both the root directory and in the disk boot sector.

QUALIFYING OS/2 FILENAMES

The source listings QFN.ASM (Figure 4) and QFN.C (Figure 5) are the last installments in my OS/2 catch-up campaign. These routines convert partial directory or file specifications into fully qualified pathnames—pathnames that include a drive and a complete path from the root directory. They are the equivalents of the DOS QFN.ASM and QFN.C routines that were published in the July and August 1988 issues of *PC Magazine*; please refer to those issues for explanations of how the routines work and are used.

The OS/2 versions of TRYQFN.ASM and TRYQFN.C are available for downloading from PC MagNet.

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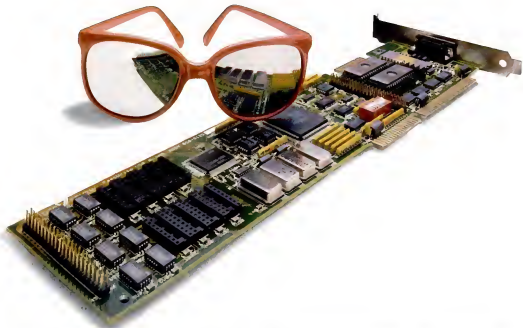
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SPREADSHEET CLINIC



Use the @TERM functions in 1-2-3 to calculate the term of a loan; convert values into word form with a nine-formula macro; gain the User key functions in 1-2-3.

A macro that compensates for the lack of a User key in Lotus 1-2-3

I use both *Lotus 1-2-3* and *Symphony*. Unlike 1-2-3, *Symphony* features a key that lets you invoke macros named without a Backslash and a single letter or number. You simply press *Symphony*'s "User" key (F7), type the name of the macro you want to invoke, and press Enter.

To simulate the action of *Symphony*'s User key in 1-2-3, I created the macro shown in Figure 1. The first statement requests the name of the macro you want to invoke. Type the name of the macro and press Enter. 1-2-3 will enter your response as a label into MACRONAME. So, if you typed ESTIMATE, 1-2-3 would enter the label "ESTIMATE into cell B5.

The next statement commands 1-2-3 to enter the result of the string formula

```
+"{Branch "&MACRONAME&"}"
```

into NEXT (cell B3—the next cell in the macro). Basically, this formula concatenates your response to {GetLabel} between the strings "{Branch " and "}" in the NEXT statement. For example, if you typed ESTIMATE in response to the {GetLabel} prompt, 1-2-3 would place the label {Branch ESTIMATE} into NEXT.

This result is a {Branch} command that routes the execution of the macro to the cell you specified. Since NEXT is the next cell in the macro, 1-2-3 will begin executing the macro you specified as soon as it recalculates the formula in NEXT.—Frank Overman; Fort Wayne, Indiana

This macro does add a much-needed feature to *Lotus 1-2-3*. However, the macro can be streamlined through the use of the {Dispatch} command, as it is shown in Figure 2.

The first statement in this macro, similar to the first one in Figure 1, solicits the name of a macro and places your response into the cell named MACRONAME (cell

B4). Then, 1-2-3 executes the statement

```
B2: '{Dispatch MACRONAME}'
```

This commands 1-2-3 to branch the macro's execution to the range whose name is stored in the cell named MACRONAME—the name you specified in response to the {GetLabel} prompt.

Figure 3 shows another useful modifi-

	A	B	C	D	E	F
1	\u	{GetLabel "Enter macro name: ",MACRONAME}				
2		{Let NEXT,"{Branch "&MACRONAME&"}"}				
3	NEXT	{Branch GOHOME}				
4		MACRONAME				
5						
6						

Figure 1: This macro enables you to invoke macros that do not have traditional names.

	A	B	C	D	E	F
1	\u	{GetLabel "Enter macro name: ",MACRONAME}				
2		{Dispatch MACRONAME}				
3						
4		MACRONAME				
5						

Figure 2: A {Dispatch} command is used to route the execution of the macro to the cell you specify.

	A	B	C	D	E	F
1	\u	/rnc {Name} {?}				
2		{Let POSITION,@CELLPOINTER("address")}				
3		{Esc 6}				
4		{Dispatch POSITION}				
5						
6		POSITION				
7						

Figure 3: This macro lets you choose the name of the macro you want to execute from a list.

■ SPREADSHEET CLINIC

cation of this technique. This macro lets you choose the name of the macro you want to execute from a list of all the named ranges in the worksheet.

The first statement commands 1-2-3 to issue the /Range Name Create command, press the F3 key, and then pause. You'll see a full-screen listing of all the range names in the worksheet. While the macro pauses, move the highlight to the name of the macro you want to execute and press Enter. 1-2-3 will highlight the range you selected in the worksheet.

While the range is highlighted, 1-2-3 will execute the command

```
B2: '(Let POSITION, @CELLPOINTER
      ("address"))
```

This enters the label form of the absolute address of the upper-left cell of the highlighted range (the range whose name you selected) into the cell named POSITION (B6). For example, if you selected the name TEST, which applied to cells B53..B99, 1-2-3 would enter the label 'B53 into POSITION.

The third statement in this macro commands 1-2-3 to press Esc six times, canceling the /Range Name Create command. Then, 1-2-3 will execute

```
B4: '(Dispatch POSITION)
```

commanding 1-2-3 to route the macro to the cell whose address is stored in POSITION; that is, the first cell in the macro whose name you selected.

A nine-formula model that converts values into word form

While looking through some back issues of *PC Magazine* recently, we stumbled upon a complex macro in the September 30, 1986, Spreadsheet Clinic that converts a value into word form. Using this macro you could convert the value 12.34 into the label ***TWELVE AND 34/100***, or the value 123.45 into the string ***ONE HUNDRED TWENTY-THREE AND 45/100***, and so forth.

Although this macro works well, its length makes it somewhat difficult to enter into a worksheet. So we developed the nine-formula model shown in Figure 4 which does the same thing. Using this you

can convert the value 1234.56 into the string *****One Thousand Two Hundred Thirty-Four Dollar(s) and Fifty-Six Cent(s)*****, for example.

The functions and formulas in cells C4..F4 of this worksheet are

```
C4: @INT(D1/1000)
D4: @INT(D1/100)-(C4*10)
E4: @INT(D1)-(C4*1000)-(D4*100)
F4: @VALUE(@RIGHT(@STRING(D1,2),2))
```

They parse the value in cell D1 into its component parts. The function in cell C4 returns the thousands component of the value (in this case, 1); the formula in cell D4 returns the hundreds component (2); the formula in cell E4 returns the tens and units components (34); and the function in cell F4 returns the "cents" component (56).

The formulas in cells C5..F5 are

```
C5: @VLOOKUP(C4,$A$1..$B$20,1)
@IF(C4<=20,"",
    ~@VLOOKUP(@VALUE(@RIGHT(
@STRING(C4,1),1)), $A$1..$B$20,1))
D5: @VLOOKUP(D4,$A$1..$B$20,1)
@IF(D4<=20,"",
    ~@VLOOKUP(@VALUE(@RIGHT(
@STRING(D4,1),1)), $A$1..$B$20,1))
E5: @VLOOKUP(E4,$A$1..$B$20,1)
@IF(E4<=20,"",
    ~@VLOOKUP(@VALUE(@RIGHT(
@STRING(E4,1),1)), $A$1..$B$20,1))
F5: @VLOOKUP(F4,$A$1..$B$20,1)
@IF(F4<=20,"",
    ~@VLOOKUP(@VALUE(@RIGHT(
@STRING(F4,1),1)), $A$1..$B$20,1))
```

They convert the results of the formulas and functions in cells C4..F4 into word form, using the vertical lookup table in cells A1..B28. Therefore, the formulas in

cells C5..F5 return the strings "One", "Two", "Thirty-Four", and "Fifty-Six". (Note: Cell B1 of the lookup table contains a null label. Also, the formulas in cells D5..F5 are simply copies of the one in cell C5.)

The function

```
C7: @IF(D1>=1000000,@CONCAT(
    ~~~~~@IF(C5="","C$ Thousand ")
    @IF(D5="","D$ Hundred ")
    @IF((C4&D5)<10,"No Dollars and ",
    @IF(E5="","E$ ")@DOLLAR(E) and ",
    @IF(F5="","F$ ")@CENT(F)*****)
```

in cell C7 uses the results of the formulas in cells C5..F5 to produce the word form of the value in cell D1. If the value in cell D1 is greater than or equal to 100000 or less than 0, this function will return the string "*****VOID*****". If the value is less than 1 but greater than 0, this function will return a string in the form "*****No Dollars and a Cent(s)*****", where a is the result of the formula in cell F5. For example, if cell D1 contained the value .34, this function would return the string "*****No Dollars and Thirty-Four Cent(s)*****".

If the value in cell D1 is less than 100 but greater than or equal to 1, the function in cell C7 will return a string in the form "*****a Dollar(s) and b Cent(s)*****", where a is the result of the formula in cell E5 and b is the result of the formula in cell F5. For example, if cell D1 contained the value 12.34, the function in cell C7 would

	A	B	C	D	E	F
1			Amount:	\$1,234.56		
2	1	One	Thousands:	Hundreds:	Dollars:	Cents:
3	2	Two		1	2	34
4	3	Three	One	Two	Thirty-Four	Fifty-Six
5	4	Four				
6	5	Five				
7	6	Six	*****One Thousand Two Hundred Thirty-Four Dollar(s) and Fifty-Six Cent(s)*****			
8	7	Seven				
9	8	Eight				
10	9	Nine				
11	10	Ten				
12	11	Eleven				
13	12	Twelve				
14	13	Thirteen				
15	14	Fourteen				
16	15	Fifteen				
17	16	Sixteen				
18	17	Seventeen				
19	18	Eighteen				
20	19	Nineteen				
21	20	Twenty				
22	20	Thirty				
23	40	Forty				
24	50	Fifty				
25	60	Sixty				
26	70	Seventy				
27	80	Eighty				
28	90	Ninety				
29						

Figure 4: The function in cell A7 of this worksheet uses the results of the formulas and functions in cells A4..D5 to convert the value in cell B1 into word form.

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return the string "*****Twelve Dollar(s) and Thirty-Four Cent(s)*****".

If the value in cell D1 is less than 1000 but greater than or equal to 100, the function in cell C7 will return a string in the form "*****a Hundred b Dollar(s) and c Cent(s)*****", where *a* is the result of the formula in cell D5, *b* is the result of the formula in cell E5, and *c* is the result of the formula in cell F5. For example, if cell D1 contained the value 123.45, the function in cell C7 would return the string "*****One Hundred Twenty-Three Dollar(s) and Forty-Five Cent(s)*****".

If the value in cell D1 is less than 100000 but greater than or equal to 1000, the function in cell C7 will return a string in the form "*****a Thousand b Hundred c Dollar(s) and d Cent(s)*****", where *a* is the result of the formula in cell C5, *b* is the result of the formula in cell D5, *c* is the result of the formula in cell E5, and *d* is the result of the formula in cell F5. For example, if cell D1 contained the value 1,234.56, as it does in Figure 4, the function in cell C7 would return the string "*****One Thousand Two Hundred Thirty-Four Dollar(s) and Fifty-Six Cent(s)*****".

If the value in cell D1 does not contain a cents component, the result of the function in cell C7 will end with the characters "No Cent(s)*****".

Calculate the term of a loan, using the @TERM function

In the May 31, 1988, issue of the Spreadsheet Clinic, K.M. Gunsteens presented a formula that calculates the term of a loan (the number of payments required to pay it off), given the amount borrowed, the monthly rate, and the amount of each monthly payment.

Gunsteens's formula works well, but it's more complex than it needs to be. In fact, 1-2-3 features a function—@TERM—that does the job quite nicely. Simply specify the monthly payment amount as the first argument, the annual rate divided by 12 as the second argument, and the principal amount multiplied by -1 as the third argument. Multiplying the result of the function by -1 returns the total number of monthly payments.

The worksheet shown in Figure 5 is an example. Cells B1, B2, and B3 of this worksheet contain the values 100,000 (the principal), 10 percent (the annual rate), and 1,000 (the amount of each monthly payment), respectively. Cell B4 contains the function

-@TERM (B3, B2/12, -B1)

As you can see, this function returns

	A	B	C
1	Amount Borrowed:	\$100,000	
2	Annual Rate:	10.00%	
3	Monthly Payment:	\$1,000	
4	Number of Payments:	215.90579	

Figure 5: The @TERM function in cell B6 of this worksheet calculates the term of the loan described by the values in cells B1..B3.

215.90579 as the number of payments—the same value returned by Gunsteens's formula.—*Bob Clark; Westminster, Colorado*

This is correct. Most 1-2-3 users use the @TERM function to calculate the number of equal periodic deposits required, at a given rate, to accrue a specified future value. For example, you might use @TERM to calculate the number of annual \$2,000 deposits required for the value of your IRA to grow to \$100,000. But it can also be used as described above—to calculate the number of periods needed to repay a loan.

It is strange that this form of the @TERM function seems to work only in Lotus 1-2-3, Release 2.01. Release 1A does not feature the @TERM function, and in Release 2, any @TERM function with a negative third argument will return the value ERR. If you use either of these releases, you will also have to use Gunsteens's formula to calculate the term of a loan.

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■ NEIL J. RUBENKING



USER-TO-USER

A faster way to copy large quantities of data between two floppy disks; have your computer execute a specific task at a certain time; get a list of filenames in a useful format.

How to list filenames in a useful format without editing

One way to get a list of *filenames* in a directory is to pipe the results of DIR and edit the file, removing the size, date, and time columns. This is not hard to do. Eliminating the spaces before the extension and replacing them with a period can be messy if the filenames vary in length. For example:

```
COMMAND.COM
ANSI.SYS
FILENAME.EXT
DATA
```

My solution is to copy the desired files to NUL and redirect the COPY command messages to a file, as in

```
COPY *.DOC NUL > DOCLIST
```

Now all you have to do to DOCLIST is delete the last line. It will look like this:

```
COMMAND.COM
ANSI.SYS
FILENAME.EXT
DATA
```

1 File(s) copied

There's some overhead here, since each file is read in its entirety. But for short files it's quick and beats the messy editing of a regular directory listing.—*Ed Volkstorf; Chesapeake, Virginia*

You can save the trouble of editing out the last line of the listing by piping the output through FIND. For example:

```
COPY *.DOC NUL | FIND /V "copied" > DOCLIST
```

Copying a file to NUL reads the data from

the file without writing it anywhere. It will also take whatever time is required to read every file you've requested.

There is a better way, though. The FOR command expands a wildcard filespec into each of its individual members. Figure 1 shows a batch file that creates a list of files matching a filespec and stores it in the output file you choose. Like COPY, above, it leaves the filenames in a useful format, but it doesn't have to read each file.

SUBST rescues compilers from contending over an environment variable

One of my first programming ventures was with BASIC. When I purchased QuickBASIC 4.0 from Microsoft, I was very pleased with its excellent programming environment. Installation was fairly simple, mainly requiring the environment variable LIB to point to the location of the libraries when linking occurred.

Recently I've started to explore other languages such as Pascal and C. When I

purchased Quick C from Microsoft, I was surprised to find that this, too, uses the environment variable LIB. This concerned me since I still plan to program in BASIC. To solve my problem, I turned to DOS. Using the SUBST command, I found a way to use the environment variable LIB for both QuickBASIC and Quick C and still keep everything separated.

First I decided to have my executables, libraries, and source programs reside on logical drives Q:, R:, and S:, respectively. (There was no special reason for using these logical drives.) I then added the following line to CONFIG.SYS:

```
LASTDRIVE=Z
```

This allowed logical drives up through Z.

Next I defined the environment variable LIB and the logical drives. I added

```
SET LIB=R:
SUBST Q: C:\QBASIC
SUBST R: C:\QBASIC\LIB
SUBST S: C:\QBASIC\SOURCE
```

to AUTOEXEC.BAT in my root directory. I also added these logical drives to my

```
ECHO OFF
IF "%2"==" " GOTO Params
IF EXIST %2 DEL %2
ECHO Storing list of files matching %1 in file %2
FOR %f IN (%1) DO ECHO %f >> %2
GOTO End
:Params
ECHO SYNTAX: "DOCLIST filespec outputfile"
:End
```

Figure 1: DOCLIST.BAT creates a nicely formatted list of files matching a template.

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PRODUCTIVITY

■ USER-TO-USER

path's environment variable. This ensured that they would be found in all circumstances. Therefore, my path command looked like this:

```
PATH C:\EXE;C:\COM;C:\BAT;  
C:\TOOLS;Q;R;S;
```

Defining environment variables using logical drives has an added advantage: it doesn't eat up too much of the limited environment space.

Finally, I created the two batch files in Figure 2 and put them in a subdirectory, C:\BAT, where all my batch files are.

A logical drive cannot be replaced with a new definition. It must first be deleted and then redefined; hence the first three lines of each batch file. The /D parameter to the SUBST command tells DOS to delete the logical drive definition. The second three lines define the new meanings of the three drives. The last two lines put the user in drive S:, and then execute the correct compiler environment. An optional filename may be specified when the batch file is executed.

If other Microsoft products use the environment variable LIB, this technique could be safely applied to these as well. To use the LIB environment variable for other applications, you simply have to create a batch file similar to those above.—David Hendrickson; Riverton, Utah

```
SUBST Q: /D  
SUBST R: /D  
SUBST S: /D  
SUBST Q: C:\QBASIC  
SUBST R: C:\QBASIC\LIB  
SUBST S: C:\QBASIC\SOURCE  
S:  
Q:QB %1
```

```
SUBST Q: /D  
SUBST R: /D  
SUBST S: /D  
SUBST Q: C:\QC\BIN  
SUBST R: C:\QC\LIB  
SUBST S: C:\QC\SOURCE  
S:  
Q:QC %1
```

Figure 2: These two batch files, QB.BAT and QC.BAT, assign drive letters for programming in BASIC and C, respectively.

I've certainly used SUBST to save myself keystrokes. It's a lot easier to type T: than CD \PROG\LANG\TURBO. But I never thought of changing the directory referred to by a given drive letter. That's one clever idea! Note, too, that your path string can be more compact when you use SUBST. For example,

```
PATH C;D;L;P;W;
```

instead of

```
PATH C;C:\APP\DOS;C:\APP\LOTUS;  
C:\PROG\PASCAL;C:\APP\NOPRO
```

SUBST first appeared in DOS 3.1.

Set your computer to execute a specific task at a certain time

In previous User-to-User columns, I have seen batch files that execute once a day and some that execute on a given day. Here's one that executes only at a given time of day: TIMEBOMB.BAT.

To use this program, copy TIMEBOMB.BAT in Figure 3 and CURRENT.BAT in Figure 4 onto your RAM drive, along with FIND.EXE and MORE.COM. Modify CURRENT.BAT to include the commands you want executed at the predetermined time. You should make sure everything is ready to go when the fateful hour strikes (for example, the tape drive is set or the printer is loaded and on-line). Then simply type

```
TIMEBOMB hh:mm;
```

where hh represents the hour in military time and mm represents the minutes. For example, TIMEBOMB 20:30; would set a timer for 8:30 p.m.

The second colon at the end of the time is mandatory in order to distinguish between hh:mm and mm:ss. In other words, it prevents releasing your program at hh:20:30 instead of 20:30:ss. The program as shown here is written for DOS 3.3, but the basic concept will work with any version of DOS.

TIMEBOMB.BAT has some limitations, the most serious being that it requires a RAMdisk. The program constantly accesses the drive, so you want to avoid putting your hard disk through a torture test. In addition, your PC cannot be used

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■ USER-TO-USER

for other work while it is patiently waiting for the correct time to spring into action.—*Ernie F. Deel; Decatur, Alabama*

If you use this method with DOS versions prior to 3.3, you'll have to make a few changes. First, add `COMMAND.COM` to the list of files you need to copy to the RAMdisk. Remove `@` from the beginning of the first line in each batch file. Last, change the line `"CALL tick"` to

```
COMMAND /C TICK.BAT
```

```
@ECHO OFF
CLS
ECHO TIME BOMB set for %1
:start
ECHO | MORE | TIME | FIND "%1" | FIND /V "-" > tick.bat
CALL tick
GOTO start
```

Figure 3: This disk-intensive batch file activates `CURRENT.BAT` at the specified time.

Really and truly, *only* use this batch file on a RAMdisk. You don't want to put any physical disk drive through such punishment.

If you want a continuous display of the current time, add this line just before `"CALL tick"`:

```
ECHO | MORE | TIME | FIND "Current"
```

This will give you a series of lines in the form `"Current time is 12:59:59.59"`, which is updated every few seconds. You may also want to move the line that echoes

```
@ECHO OFF
ECHO %1 %2 %3
REM *** Your commands go here ***
PAUSE
```

Figure 4: Whatever you put in `CURRENT.BAT` will be executed at the time passed to `TIMEBOMB.BAT`.

the alarm time to after `"start"` instead of before it.

Why does it work? Before the correct time, the `FIND` lines filter out all output from `TIME`, leaving `TICK.BAT` empty. When the output of `TIME` includes the specified time, it gets written to `TICK.BAT`; for example, `"Current time is 12:00:01.25."` Now `TIMEBOMB` calls `TICK`, and `TICK` calls `CURRENT`, which performs whatever tasks you've listed. Do note that if the commands in `CURRENT.BAT` take less than a minute to execute, they'll be called again in the next loop of `TIMEBOMB.BAT`.

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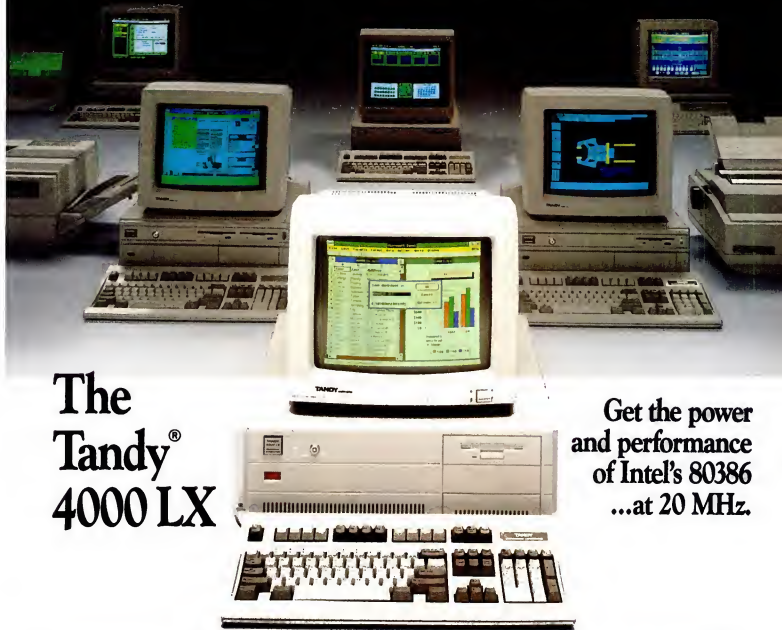
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■ USER-TO-USER

This is a very good point. It's faster to copy between two floppies using a RAM-disk. And if you just have one floppy, it's

much faster and avoids unnecessary disk swapping.

You can simplify the batch file in

```
ECHO OFF
IF NOT ERRORLEVEL == 8 GOTO :ERROR
IF "%1" == "" GOTO :INSTX
IF "%2" == "" ECHO COPYING FILES %1 TO CURRENT DIRECTORY/PATH THROUGH D:\TEMP
IF NOT "%2" == "" ECHO COPYING FILES %1 TO %2 THROUGH D:\TEMP
MD O:\TEMP
COPY %1 O:\TEMP
COPY D:\TEMP\*. * %2
IF NOT EXIST RCOPY.0AT ECHO "RCOPY.0AT"
IF EXIST RCOPY.0AT DEL O:\TEMP\*. * < RCOPY.0AT > NUL
IF NOT EXIST RCOPY.0AT ECHO DELETING ALL FILES IN \TEMP
IF NOT EXIST RCOPY.0AT DEL D:\TEMP\*. *
RD /TEMP
GOTO :END
:INSTX
ECHO .
ECHO SYNTAX IS THE SAME AS MS-DOS "COPY".
ECHO RCOPY [drive:]([path]) [filespec] [drive:]([path]) [filespec]
ECHO (WILDCARDS ARE ALLOWED, DEFAULT DRIVES/PATHS OBSERVED)
ECHO .
ECHO ADDITIONALLY:
ECHO - YOU CAN COPY TO THE SOURCE DRIVE USING THE SAME FILENAME
ECHO - DISPLAY THIS HELP BY TYPING "RCOPY" WITHOUT PARAMETERS
GOTO :END
:ERROR
ECHO ERROR ENCOUNTERED DURING RCOPY
:END
```

Figure 6: RCOPY.BAT copies files from one floppy disk to another using a RAMdisk.

Figure 6 and avoid the need for the file RCOPY.DAT. Find the four lines in a row that refer to the existence of RCOPY.DAT. Delete them and replace them with this single line:

```
ECHO Y | DEL D:\TEMP\*. *
```

Piping the echoed Y into the DEL command is the same as using RCOPY.DAT, but it saves some batch lines.

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■ EDITED BY CRAIG L. STARK

POWER USER



Microsoft Word tips on how to speed up marking index entries, substitute the blank form feature for bookmark markers, and automatically save all files in all windows.

Here's a tip on how to save all files in all windows automatically in Microsoft Word

When working with several documents in *Microsoft Word*, saving each separately can be a chore. The macro below illustrates a way to save all documents in all windows:

```
ctrl esc>tab 2>center>
ask n?Enter Number of Open Windows (1-8)>
message saving all documents . . .
repeat n=ctrl f1>endrepeat
ctrl esc>tab 2>center>
```

The first and last lines are for users who normally leave their menus turned off. The first line turns the menus on so that *Word* will display the message entered in line three. The last line turns the menus off again. (If you normally leave your menus turned on, omit the last line.) The second line asks for the number of open windows. The fourth line saves each window, moves to the next, and finally returns you to the window from which you started after the last window is saved.

Note that this macro is designed for files that have already been saved at least once, as the files are saved to their previously defined paths and filenames. Trying to save new documents will result in error beeps. No damage will be done, but the files will not be saved.—*Gary Pollack; Eugene, Oregon*

There are at least three useful refinements you can add to the macro, as shown in Figure 1. First, by using the While . . . Endwhile command instead of the Ask com-

mand, you let the macro itself decide how many windows there are to save. Lines 2 and 3 in Figure 1 save the first window, center and then highlight xxx, and move on to the next window. Line 4 checks to see if the highlighted selection in the current window is xxx. If it is not, the macro saves the current window, moves on to the next window, and checks for xxx again. It will repeat this checking process until it comes back to the original window.

The second refinement utilizes Esc Transfer Save (line 6) instead of Ctrl-F10 to make the save, and it also adds a pause after the Save command. This forces the macro to stop and let you enter the name you want to save it under. If you have the summary sheet option turned on, you'll also need a second pause command, as shown in Figure 1.

Third, by using the If . . . Endif command (line 6), you can have the macro test to see whether the file already has a name. The macro in Figure 1 will save the file if it already has a name, and will stop to let you enter a name if there is none.—*M. David Stone*

Add a Goto command in Microsoft Word to zip through text or highlight selections

Many word-processing programs have a Goto command to move the cursor to any designated character. The macro shown below effectively adds this feature to *Microsoft Word*:

```
ask text?Enter character>
while text<>
ctrl esc>tab 2>center>
if not found>quit>endwhile
ask text?Enter character (Enter = Accept)>
endwhile
```

When invoked, the macro prompts you for a character to move to. If you enter a comma, for example, the highlight will move to the next comma, where you're prompted either to accept the current position or to enter a character to move to again. To stop the macro, just hit Enter by itself.

Note that you can use this macro as a subroutine within other macros. For example, if you add an F6 to the beginning, the macro will extend a highlight to the chosen characters, rather than move to them. If

```
<ctrl esc>O>tab 2>y<enter>
<esc>t>shift f1>shift f1>f1>
xxx<shift f1>shift f1>f1>
while selection <> "xxx">
message saving all documents . . .
<esc>t>shift f1>shift f1>f1>
f1>endwhile<del>
<ctrl esc>O>tab 2>n<enter>
```

Figure 1: This Word macro will save all open files. It automatically checks to see if a document has been saved to a file and if it hasn't, the macro stops to let you enter the filename for the save.

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you add an F6 before and a Del after, the macro will highlight the selection and automatically delete it.—*Daniel Hobart; Saint Michel d'Euzet, France*

Unlike the Goto commands in most programs, this macro requires that you use two keystrokes: the character itself and an Enter to tell the macro that you're done. At first glance this may look clumsy, but the advantage gained is that you can use Hobart's macro to look for specific words, not just characters. In fact, you can use it (without the highlight extension) to double as a standard search macro.—*M. David Stone*

Here are two macros that will speed up marking index entries in Microsoft Word 4.0

Microsoft Word 4.0 comes with a very clumsy macro for marking index entries. The macro inserts an .i. (to mark the beginning of an entry) and a semicolon (to mark the end) as hidden text, but it only works with single words. If your entry is "Russian rulers," the macro will mark "Russian," and you will then have to move the semicolon. Further, the supplied macro does nothing to help mark subentries.

Here's a macro that will automatically mark any highlighted text, whether a single word or a phrase:

```
<del><alt x>e.i.<alt space><left><ins><right>
```

And here is another one that will let you identify index subentries with predefined superentries:

```
<del><alt x>e.i.Russian Rulers ;  
<alt space><left><ins><right>
```

In this example, the superentry is "Russian rulers." If you are marking the file for several superentries, you will want a separate macro for each.

After indexing a document with superentries, the extra text can be distracting. However, note that the second macro shown above formats the superentry as Hidden Text. If you set the Show Hidden Text option to No (under <Esc> Window Options), the superentries will not show on-screen.—*Salvatore P. Ricciardi; Chicago, Illinois*

The index macro that came with my copy of Word 4.0 works without problems on multiword phrases. However, the first macro presented here uses fewer keystrokes to produce the same result. Ricciardi's second macro is a highly useful enhancement.

A shortcoming of these macros and of Word's own index macro is that they all assume you have already highlighted the index word or phrase when you call up the macro. To me, it seems more natural to define the item to index as part of the macro, as in the following:

```
<rt><rt>=pause extend the highlight to cover  
the entire phrase to index<del>  
<alt x>e.i.<alt space><left><ins><right>
```

To use this version, place the cursor on the word (or on the first word in a phrase) you want to index. The macro will highlight the word with F8, turn on the Extend Selection feature with F6, and pause. To index a single word, hit Enter. To index a phrase, just extend the highlight and then hit Enter.—*M. David Stone*

Productivity Tip

In WordPerfect 5.0, Alt-F3 does not "reveal all," as promised. Some of your document's formatting information, notably the printer selection, gets stored at the beginning of the file, before the text.

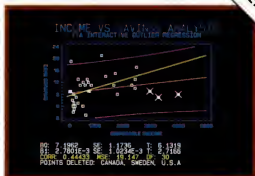
You can use the blank form feature in Microsoft Word 4.0 to substitute for bookmark markers

If your word processor lacks the equivalent of WordStar's Marker command, you usually have to keep your place when flipping back and forth between portions of a document by inserting strings of meaningless characters, such as xxx, and then using the program's search feature to find them. Microsoft Word 4.0 offers a better solution, which uses a feature actually intended for building on-screen, fill-in-the-blanks forms. This feature is faster than using the Find command, and it requires fewer keystrokes.

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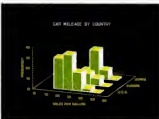
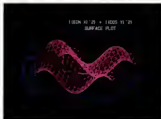
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wherever you want in the document. To return to your bookmark, press Ctrl->. This sends the cursor to the next chevron in the file. If there are no chevrons between the cursor position and the end of the file, the search will begin again at the top of the file.—Steven Chan; Toronto, Ontario, Canada

Using this feature to mark your place has yet another advantage. If you have multiple markers in your file, you can use Ctrl-> to move forward one marker at a time, or Ctrl-< to move back one marker.

Of course, being able to open several windows on the same file in Word may itself make the use of markers unnecessary. You can jump from one window to another, or even look at both parts of the file simultaneously. Jumping between full-screen windows has much in common with using markers. Looking at more than one window at a time goes a step further.—M. David Stone

The If command in Microsoft Word macros can let you branch to your choice of subroutines

Although Microsoft Word 4.0 lacks a Goto command for its macros, you can use the If . . . Else . . . Endif command to achieve the same result. Suppose, for example, that you have three form letters recorded under the glossary names Receipt, Conf, and Request. If all three share the same heading for date, placement on the page, and so forth, you can create a single heading macro, and end it with an Ask command such as

```
ask type=? Which form letter to use? 1=receipt,
2=confirmation, 3=request for service
```

This tells the macro to stop and wait for you to enter a number. The final command in the macro should be

```
if type="1">receiptf3>else>testf3>endif.
```

Entering a 1 will expand the Receipt glossary entry in your document. Any other entry will call on the test1 macro.

Test1 should look like this:

```
if type="2">conf<f3>else>test2<f3>endif.
```

This will expand the Conf glossary entry if

you entered a 2. Otherwise, it will call on the Test2 macro, which will expand the Request glossary entry. Since each macro calls on the next in a chain, you can extend the branching to any reasonable number of choices.—Paul R. Murphy; Fanwood, New Jersey

It's certainly a useful way to provide menu selection within a macro, but there's an easier way to do it. Just put all the If commands in one macro and drop the Else statement, as in the following:

```
ask type=? What type of form letter? (1-3).
if type="1">receiptf3>endif.
if type="2">conf<f3>endif.
if type="3">request<f3>endif.
```

This will function in exactly the same way as Murphy's linked macros. Word will simply run through the list of If commands, skipping to the Endif statement each time the condition is false and expanding the macro the one time the condition is true.

Also note that you can get the same result by putting the entire text of each letter in its own If . . . Endif statement. This might be unwieldy with entire letters, but the same technique works nicely, letting you choose among alternative boilerplate paragraphs within a letter.—M. David Stone

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■ EDITED BY ROBERT L. HUMMEL

LANGUAGES



Detecting printer errors is simple with this C program; hints to free up memory when debugging large programs with Turbo Pascal 5.0 and the Turbo Debugger.

Detecting printer errors and shortening printer timeout in C

I've written a printer driver that detects printer errors (out-of-paper, paper jam, and so forth). While I want it to be useful in a variety of C programs and compilable with a number of compilers, the version submitted here works with Borland's Turbo C. I found that the Turbo C biosprint() function could be used to detect the proper error code when the printer failed. —H. Austin Hummel; Bloomington, Minnesota

The PCPRINT.C program shown in Figure 1 uses interrupt 17h, the BIOS printer interrupt. There are three functions performed by interrupt 17h: sending a character to the printer, initializing the printer, and getting the printer status. Since the status can be retrieved whenever a character is sent to the printer, you can check the status of every character or group of characters. Fortunately, the biosprint() function and its counterpart in the MSC 5.0 library, _bios_printer(), both allow you to pass an entire string of characters to the printer and return any resulting error codes.

Only a few of the bits returned by these functions are valid for printer error checking; the result should be ANDed so only these bits are checked. This is done in the function PcPrint(), which returns a non-zero value if a printer error has occurred. The error value can be checked by the function PcPrinterr(), which will print the appropriate error message on the screen.

It's not necessary to use PcPrinterr(); it just shows you how these bits might be interpreted for an application program. Note that if the printer is turned off, I/O error and Out-of-Paper error bits are set.

One annoying characteristic of inter-

rupt 17h is its tendency to take too long to report an error. To prove this to yourself, compile PCPRINT.C with the calls to SetPrTimer() and GetPrTimer() removed. Then, with your printer turned off, run the program. Be patient! Although this re-

```

/* pcprint.c
 * For MSC 5.0/QuickC: cl pcprint.c
 * For Turbo C:      tcc -DTURBOC pcprint.c
 */

#include<stdio.h>
#include<bios.h>

/* printer error code bits */
#define PR_TIMEOUT      0x0001
#define UNUSED_1        0x0002
#define UNUSED_2        0x0004
#define PR_IOERR        0x0008
#define PR_SELECT       0x0010
#define PR_PAPEROUT     0x0020
#define PR_ACKNOWLEDGE 0x0040
#define PR_NOTBUSY      0x0080

#define PRINT_ERRS 3

struct _printerrs
{
    char *errmsg;
    int errval;
} printerrs[PRINT_ERRS] =
{
    "Printer time out", PR_TIMEOUT,
    "I/O Error", PR_IOERR,
    "Out of Paper", PR_PAPEROUT,
};

/* general purpose macros */
#define PRINTER_ERRBITS (PR_TIMEOUT | PR_IOERR | PR_PAPEROUT)
#define LPT1 0
#define LPT2 1
#define PRINTER_TIMEOUT_ADDR 0x00400076
#define PRINTER_WRITE 0

/*
 * this function sets the printer timeout to 'val' for printer 'pr'
 */
void SetPrTimer(val, pr)
int val, pr;
{
    unsigned char far *Pr_tim_out = (unsigned char far *)PRINTER_TIMEOUT_ADDR;
    (continues)

```

Figure 1: A C program that demonstrates working with the printer and handling errors.

■ LANGUAGES

sponse may have been acceptable when PCs and printers were slower, the default time-out value is too high (14h on my machine). It can be set to a smaller value, and the printer error will return more quickly.

The `SetPrTimer()` and `GetPrTimer()` functions set and get the timer value for each printer. This value is found in the BIOS data area at 40:78h. If you cast a far pointer to that address, these functions can access and change the byte to a value that will speed up the error return time. You

can set this to a value as low as 1, as PCPRINT does. Be sure to reset it to its original value for the sake of other, less enlightened applications.

To compile PCPRINT for MSC and Quick C, use:

```
cl pcprint.c
```

For Turbo C, use:

```
tcc -DTURBOC pcprint.c
```

—Richard Hale Shaw

Debug large programs with Turbo Pascal 5.0 and the Turbo Debugger

Turbo Pascal 5.0's integrated debugger and the new standalone Turbo Debugger allow programmers to find and solve problems faster than ever before. Unfortunately, those of us working on large programs still have to cope with the ever-present memory crunch. Even if you don't have EMS memory or a 386 machine or a second computer to use for remote debugging, there are still some techniques that you need to know for using the new debuggers on your big programs.

If you try to debug your program and find that you've run out of memory, the first trick is to free up as much memory as possible. First, unload any resident software you normally use like *SideKick* or *PRINT*. Then check your `CONFIG.SYS` file and remove any unnecessary device drivers. Allocate as few buffers, files, and stacks as possible (say, `buffers=8`, `files=20`, and `stacks=0,0`) to make DOS as small as possible.

Now install the Turbo Debugger or Turbo Pascal to use as little memory as possible. For Turbo Debugger, use `TDINST` to set the 25-line mode on EGAs and not allow 43-line mode. If you're not debugging a graphics program, turn off Complete Graphics Save. Reduce the Log List Length, reduce the size of the History Lists, and set Screen Update to Flip. You can also experiment with the `-M` command-line option to set the debugger's heap size.

For Turbo Pascal, use `TINST` to set the Compile Destination to Disk, Link Buffer to Disk, turn off Full Graphics Save (if you're not debugging a graphics program), turn Standalone Debugging off while using the integrated debugger, turn off 8087 emulation if you don't need it, and reduce the size of the Edit Buffer to as small as possible for your source files. If it's practical, use Turbo Pascal 5.0's new overlays to reduce memory requirements as much as possible, remembering that speed of execution isn't critical during debugging. You may want to overlay during debugging and remove the `{SO}` directives for the working program.

If your program still won't fit, then it's

```
Pr_tim_out[pr] = val; /* set printer time out value */
}
/*
 * this function gets the printer timeout value for printer 'pr'
 */
int GetPrTimer(pr)
int pr;
{
    unsigned char far *Pr_tim_out = (unsigned char far *)PRINTER_TIMEOUT_ADDR;
    return Pr_tim_out[pr]; /* get printer time out value */
}
/* this function prints an error message for the printer error bits set
 * in errvel
 */
void PcPrinter(errvel)
unsigned errvel;
{
    int i;
    printf("\nPrinter error: ");
    for (i = 0; i < PRINTER_ERRS; i++)
        if (errvel & printerErrs[i].errvel)
            printf(" %s", printerErrs[i].errmsg);
}
unsigned PcPrint(str, pr)
char *str;
int pr;
{
    unsigned retvel;
    for (; *str; str++)
        if (retvel = biosprint(PRINTER_WRITE, (unsigned)*str, pr)
            & PRINTER_ERRBITS)
            return retvel;
    if (retvel = bios_printer(PRINTER_WRITE, pr, (unsigned)*str)
        & PRINTER_ERRBITS)
        return retvel;
    return 0;
}
main()
{
    unsigned retvel;
    int nldval;
    oldval = GetPrTimer(LPT1); /* get old timer value */
    SetPrTimer(1, LPT1); /* set new timer value */
    if (retvel = PcPrint("this is a test\n", LPT1)) /* print the string */
        PcPrinter(retvel); /* report any error */
    else
        printf("\nPrint test was successful");
    SetPrTimer(oldval, LPT1); /* set the timer value */
    exit(0);
}
```

(Figure 1 ends)

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Note that you must use Build and not Make or Compile to make the conditional directives take effect.

You can take this one step further and have the compiler remove the code for those sections you're not testing. To do this, change the program framework in Figure 2 to look like Figure 3.

Now, when you build the main program, you'll include only those units that you're actually testing and leave out the code and symbols for the other units. For example, defining AddCust will compile the AddACustomer routine with all debugging options on and omit all other func-

tions in the program (except quitting).

The only problem with this is that it's difficult to compile a full working version of your program. You can either list all of the individual units in the conditional definition (in this case, AddCust;DelCust;DispCust), or add an All directive like this to the top of the main program:

```
{IFDEF All}
{DEFINE AddCust}
{DEFINE DelCust}
{DEFINE DispCust}
{ENDIF}
```

When you compile the main program, using All in the conditional directives will in-

```
PROGRAM Whatever;
USES Crt, TAccess, AddCust, DelCust, DispCust, Menu;

VAR QuitFlag : Boolean;

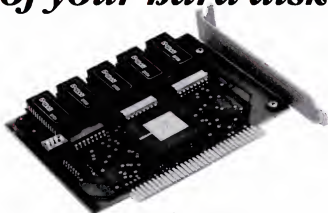
BEGIN
  Initialize;
  QuitFlag := False;
  REPEAT
    CASE GetMenuChoice OF
      1 : AddACustomer;           { This routine is in AddCust }
      2 : DeleteACustomer;        { This routine is in DelCust }
      3 : DisplayACustomer;        { This routine is in DispCust }
      4 : QuitFlag := True
    END
  UNTIL QuitFlag;
  Cleanup
END.
```

Figure 2: The framework of an imaginary program to be debugged.

```
PROGRAM Whatever;
USES Crt, TAccess,
  {IFDEF AddCust} AddCust, {ENDIF}
  {IFDEF DelCust} DelCust, {ENDIF}
  {IFDEF DispCust} DispCust, {ENDIF}
  Menu;
VAR QuitFlag : Boolean;
BEGIN
  Initialize;
  QuitFlag := False;
  REPEAT
    CASE GetMenuChoice OF
      {IFDEF AddCust} 1 : AddACustomer ; {ENDIF}
      {IFDEF DelCust} 2 : DeleteACustomer ; {ENDIF}
      {IFDEF DispCust} 3 : DisplayACustomer ; {ENDIF}
      4 : QuitFlag := True
    ELSE
    END
  UNTIL QuitFlag;
  Cleanup
END.
```

Figure 3: The imaginary program framework of Figure 2, with conditional compilation code added to aid debugging.

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■ LANGUAGES

clude all of the menu functions.

Using these techniques and carefully organizing your program will permit you to debug programs of almost any size, even on less-than-state-of-the-art machines.—Scott Bussinger, Tacoma, Washington

There are a few other ways to save RAM for debugging. On a system that has expanded memory, Turbo Pascal uses 64K of it for the edit buffer, thus freeing 64K of normal RAM for your program. The standalone Turbo Debugger will use almost no RAM if you configure it for 80386 use. And if you have two computers, you can connect them with a serial cable and use Turbo Debugger on one to debug programs on the other. This last method takes 15K on the machine that's being debugged.

One other point. There are two ways to define conditional symbols, both of which are used in the above discussion. First, you can define a symbol right in the code of a Unit, using the `{DEFINE}` meta-command. Such a symbol is defined only in that Unit. Second, you can define a symbol globally using Options/Compiler/Conditional defines in the integrated environment or the `/D` switch in the command-line compiler. When you define a symbol globally, it's recognized in every Unit.

The final example of the All symbol demonstrates both kinds of definition. If All is defined, then the compiler also defines three local symbols. This definition affects only the main program, instructing the compiler to include the Units and code related to those three symbols. It does not affect the other Units, so they are compiled without any debugging code.—Neil J. Rubenking

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■ ROBERT L. HUMMEL

PC TUTOR



Interchanging font files among application programs; adding support to hard disks by altering the disk controller; memory options can be limited on some AT compatibles.

Source code and machine code are different versions of the same information

I have used and greatly enjoyed the utilities provided in your Productivity section. It intrigues me, however, that I can't generate the real programs. Why is it that an assembly or BASIC program creates the actual program that we use in the end?—Fred W. Erickson; Orem, Utah

Computers in general, including the IBM PC, are able to process information only when it is presented as binary data known as machine code. Because it is in a binary form intended for a computer, machine code is not easily understood when viewed by humans. To make the programming of computers easier for humans, assembly language was developed.

Assembly language uses an easily understood mnemonic instruction to represent each machine code instruction. So, for example, the machine code instruction

```
10110100 00110111
```

can be written as assembly code in the more understandable form of

```
MOV AH, 34h
```

Assembly language listings, such as those provided in the Utilities section, are known as source code and are translated by the assembler into their machine code equivalents. The BASIC program listed in each Utilities column is an alternate method of creating a file for those readers who

don't own a copy of an assembler. It simply stores an executable file as DATA statements that can be easily printed and typed in, and then re-creates the file when run. For more information on the way the BASIC program works, see the Utilities column, September 27, 1988.

A PC-XT can be modified to add support for new hard disks by altering the disk controller ROM

The fixed disk BIOS in the IBM PC-XT hard disk controller supports only four different sets of hard disk parameters. I would like to change the ROM on the hard disk adapter. What are the equivalent EPROMs that I can use?—Henry Chang; Palos Verdes, California

There is nothing very mysterious about ROM (read-only memory) chips. They simply contain software programs in an unerasable format. Modifying and replacing ROMs with EPROM (erasable, programmable ROM) chips involves two small steps: a hardware task and a software task.

The hardware part of the job is the easiest. The mechanics of "burning" an EPROM are simple. Many mail-order firms and computer stores sell "PROM burners" that come complete with all the correct hardware and control programs needed to perform the task.

The modification also requires some software skill because you are, in essence, patching an executable program. A .COM

file that has been badly modified with DEBUG isn't likely to run properly. But a badly modified ROM will probably stop the computer system from running at all.

The ROM chip on the XT hard disk controller holds 8K of data and is addressed starting at C800:0000h. To replace it, use a 2764 EPROM. The "27" indicates the family of EPROM that the chip belongs to, and the "64" indicates the number of kilobits the chip contains. Thus, 64 kilobits arranged as an array of 8-bit bytes yields 8K of storage.

Memory options for dividing system board RAM can be somewhat limited on some AT compatibles

My mail-order AT clone came equipped with 640K on the motherboard configured as two 256K banks and two 64K banks. Because it was billed as "expandable to 1MB," I replaced the existing 64K chips with 256K chips in order to get some extended memory.

After setting the configuration switches and running the SETUP program, I discovered that the hardware would not allow me to allocate memory as 640K of conventional and 384K of extended. Instead, my only option was 512K of conventional and 512K of extended. Is there an inexpensive way to get around this limitation? I know I could purchase a memory board that would backfill conventional memory to 640K, but that seems like an expensive option.—Robert J. Strelau; Hightstown, New Jersey

■ PC TUTOR

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CIRCLE 349 ON READER SERVICE CARD

The 80286 chip can address a full 1MB of memory when operating in real mode. The IBM PC AT design, however, assigns the top 384K of the 1MB address space to ROM (read-only memory), leaving only 640K of address space for RAM. Any additional RAM must be addressed after the 1MB boundary.

The problem of RAM addressing on a system board appeared when manufacturers began allowing four banks of 256K RAM to be installed. Because the IBM design required that the lower 640K of RAM be addressed differently than the top 384K of RAM, it required special hardware and influenced the design of the system board.

To save money, some manufacturers don't support split addressing. Unfortunately, yours is one of them. Your best solution would be to reinstall the 64K chips on your system board, for a total of 640K. Then buy a memory expansion board and install the two banks of 256K chips.

If you select the correct printer driver, *WordPerfect* can output draft printouts instead of NLQ

Using the November 11, 1986, *PC Magazine* printer issue as my guide, I purchased a Panasonic KX-P1091i II dot matrix printer. However, I'm experiencing a problem that I hope you can solve.

I use the printer with a Compaq Deskpro and *WordPerfect* 4.2. Regardless of the position of the print mode selector switch, the printer makes a double pass and produces near-letter-quality (NLQ) output. Although I have tried fonts 1 through 5 from within *WordPerfect*, I still cannot get the printer to print in draft mode. Do I need to reset the DIP switches to make it work in draft mode, or is this not the problem? I would sincerely appreciate any help that you could give me with this printing problem.—Lyle K. Holmes; APO, New York

The problem you're having is not with the printer, but with the *WordPerfect* printer driver. The *WordPerfect* program itself doesn't know what type of printer you have attached to your computer. It is the printer driver's responsibility to communicate with the hardware, and it is giving the

instructions to your printer to make two passes. As long as you use the Panasonic KX-P1091i driver, you will get NLQ output instead of draft.

To get the single-pass, or draft, output you want, simply select another printer driver. *WordPerfect* 4.2 will support up to six different printer definitions. Simply define a new printer and select the definition "DOS text printer." When you wish to print in draft mode, use the printer number assigned to this definition. The characters will be passed to the printer without interference.

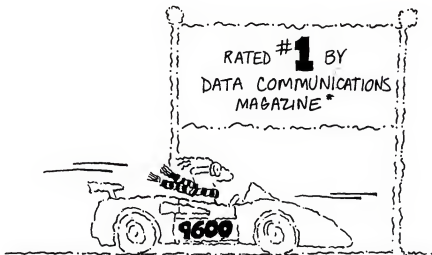
An 80386 can speed up most ROM operations by duplicating the ROM code in shadow RAM

I have an AST Premium/286 computer with 1MB of RAM, an ATI EGA Wonder video card, and a NEC MultiSync II monitor. This combination works quite well, but the screen updates can be slow. Some of the new 386 machines map the machine BIOS and the video BIOS from ROM into RAM with the intent of speeding up the display.

Is there a program that could do this on my machine? If so, would there be a noticeable improvement? If this was done, where in memory does the code go? —Gary Pritchard; Toronto, Ontario, Canada

The amount of time the PC must take to read information from ROM (read-only memory) is generally greater than the time spent reading the same information from RAM (random-access memory). Because of this, copying the BIOS (Basic Input/Output System) program to RAM will generally speed up a computer's performance. ROM code, however, is usually written to execute at a specific address and cannot be relocated by simply copying the code to another location.

On your 80286 computer, assuming the ROM could be patched to run in a new location, the memory occupied by the ROM would be removed from the 640K allowed for programs. Since the typical BIOS ROM for an AT takes up 32K, this much memory would be taken up as if the BIOS were a TSR program.



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■ PC TUTOR

On an 80386 computer, however, the rules change. Memory located at any physical address can be "mapped" by the 80386 to seem to appear at another address. Thus, a 32K section of memory, physically located past the 1MB limit of DOS, can be mapped to appear in the same location as the original BIOS ROM. The ROM code is copied to the new section of RAM, then the mapping is performed. The result is faster-executing ROM code. This technique is generally referred to as "shadowing."

Interchanging the many font files from different application programs isn't generally practical

My problem is the general proliferation of fonts, which seem to be eating up all the real estate on my hard disk. I have fonts everywhere! I've got screen fonts, printer fonts for my HP LaserJet Series II, fonts for Microsoft Windows, fonts for Microsoft Excel, and fonts for GEM. I've even got fonts from Bitstream that I use with Ventura Publisher. Is there anything I can do to allow me to use these fonts with other packages? I'm not a novice with PCs, but all these fonts have me baffled. Is there a book or software package that can lead me out of the font jungle?—Roger Crowley; Great Mills, Maryland

Your problem with multiple fonts isn't unique. Software publishers tend to design their products to use proprietary file and font formats. This isn't necessarily to be incompatible, but to enhance some specific aspect of their program's performance. Plans to use a common format are also hampered because no widely accepted standard for font formats is employed by software developers. Users are required to carry the burden in the form of more files to store.

Some companies, like Bitstream, manufacture the fonts themselves. The program developers may convert the fonts to their own format and include them with a package or provide a conversion utility. Unfortunately, there's no general method for determining which fonts are compatible with which package—other than the one they came with.

EGAs don't display wide borders and sometimes don't work with screen-recall programs

When I had a CGA monitor, I had no dark margin around my monitor. I am told that it is the nature of the EGA monitor to have a dark margin. The majority of the screen responds to COLOR.COM. Do you know how I can get color over the entire surface of the EGA monitor?

With the CGA monitor, I used a program called WAITASEC that would allow me to scroll back anything that went off the screen. Since I started using my EGA, I find that these programs do not backscroll beyond what is on the screen. Do you know why?—Sherwood L. Shulman; Bradenton, Florida

The area of the display that appears as a border is referred to as the overscan area. On a CGA, this area is quite a bit larger than on the EGA. As you note, this is a characteristic of the design of the EGA specification, and it isn't something that can be fixed easily.

If you're willing to experiment, however, some partial solutions were given by Charles Petzold in *PC Magazine's* two-part series "Exploring the EGA," August 1986 and September 16, 1986. Programs like WAITASEC (Power Programming, *PC Magazine*, November 26, 1985) depend on intercepting the Scroll Screen function request to make a copy of the line of text that is about to roll off the top of the screen. To increase the display speed, some EGA cards perform this function internally. Thus WAITASEC is never notified that it must save the text.

Ask the PC Tutor

The PC Tutor solves practical problems and explains points of general interest about using your hardware and software more productively, and answers basic questions about DOS and systems in general. To see your questions answered here, drop a line to PC Tutor, *PC Magazine*, One Park Avenue, New York, NY 10016. We're sorry, but we cannot answer questions personally.

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CONNECTIVITY CLINIC



Clustered CPU cards make remote LAN connections easy; SRVCLOCK and NETCLOCK updated; a model for IBM's High Level Language Application Program Interface.

Writing code for IBM's HLLAPI is easy if you have a model

Your coverage of LAN gateways in Connectivity Clinic (December 13, 1988) mentioned that IBM's High Level Language Application Program Interface (HLLAPI) made it possible to automate the process of signing on to a mainframe computer. However, I wonder how hard it is to use this interface. Can you give an example?—Gil Milligan; Destin, Florida

The C language program in Figure 1 is an example of a mainframe session sign-on using HLLAPI. I must emphasize that

TSO.C is a bare-bones program that needs the addition of a lot of error-trapping routines and a user friendly interface before it is practical.

This example underscores the primary conclusion of our gateway reviews: you need to have a very good understanding of the mainframe communications link process before you try to install a LAN gateway. However, it also shows that the calls from C (or other high-level languages) are easy to use.

Functions such as ddoconn (connect presentation space), doskey (enter a stored string), and dopause are intuitive functions and have a syntax that is easy to use. The sample program clearly shows how the

functions are formatted and called.

It is relatively safe to experiment with HLLAPI programming. HLLAPIs are available for many gateways, and the front-end processors of IBM systems are reasonably tolerant of stations trying to log in. Using HLLAPI is a good way to learn more about mainframe communications and how to control communications links.

Two favorite network time-keeping programs are updated and revised

I revised my SRVCLOCK and NETCLOCK programs to be more reliable in large networks and where SRVCLOCK

```

/* TSO.C This program is a very simple example of how to log on to
 * a TSO session using the HLLAPI programming interface. This
 * program does no checking for any error conditions which
 * might occur during the signon process. */

/* EXTERNAL DECLARATIONS SECTION */
/* Entry point for the Language Interface Module
 * (LIM) where the HLLAPI commands are processed */
extern apglim();

/* GLOBAL DATA SECTION */
char buf[80];
int len, spc_pc, func;

main() {
    ddoconn('A'); /* Connect Presentation Space on session 'A' */
    doskey("1 TWOIDEN"); /* Enter TSO Logon ID */
    dopause(40); /* Wait for 30 secs for host to send NO BIND session */
    doskey("PASSWORD"); /* Enter Password */
    dopause(30); /* Wait 15 secs for host to display READY prompt */
    doskey("GOODBYE"); /* Logout of TSO session */
    dopause(30); /* Wait for 15 secs for host to UNBIND session */
    ddoconn(); /* Disconnect Presentation Space */

    /* Connect Presentation Space (Function 1) */
    ddoconn(session)
    {
        func = ACONNECT;
        len = 1;
        buf = session;

        buf[len] = '\0';
        invoke();
    }

    /* Disconnect Presentation Space (Function 2) */
    ddoconn() {
        func = ADISCONN;
        invoke();
    }

    /* Send Key (Function 3) */
    doskey(str)
    {
        len = strlen(str);
        strcpy(buf, str);
        buf[len] = '\0';
        func = ASENDKEY;
        invoke();
    }

    /* Free (Function 18) */
    dopause(10);
    intlim();
    {
        len = time;
        func = APAUSE;
        invoke();
    }

    /* Invoke: Calls the Language Interface Module (LIM)'s main routine. */
    invoke() {
        return( apglim(func, buf, len, spc_pc) );
    }
}

```

Figure 1: This simple program, TSO.C, needs error-trapping routines to be practical, but it serves as a good example of how to use the C programming language to interact with IBM's High Level Language Application Program Interface (HLLAPI).

■ CONNECTIVITY CLINIC

must handle multiple requests.

I have improved the performance of SRVCLOCK by separating the NetBIOS "listen" and "send" functions and linking them via a circular buffer. This combination produces a system that resists errors and handles requests efficiently.

My changes to NETCLOCK include a retry for the call routine (in case SRVCLOCK does not have a listen currently pending) and enabling it to deliver an errorlevel on exit.

We tested the programs in a number of large environments and with multiple machines that were repeatedly calling SRVCLOCK. In our tests the new SRVCLOCK program recovered from errors, whereas the old SRVCLOCK version was unable to answer any of the new calls after an error.

Note that SRVCLOCK reads the CMOS (complementary metal-oxide semiconductor) RAM to obtain the date and time. The machine that's running SRVCLOCK must have a clock in CMOS at the same locations as an IBM PC AT.

—Alan Queen; Boise, Idaho

Having the correct—or at least the same—time on all network stations is important in many applications. Applications for data entry, billing for professional services, and order entry are just a few types of jobs where it is important to keep accurate time. The SRVCLOCK and NETCLOCK programs work together to pass the time of day from one machine to all others on the network.

The original SRVCLOCK and NETCLOCK programs are our most popular LAN utilities and are available on PC MagNet. In fact, many subscribers have commented on their value in the PC MagNet forums.

SRVCLOCK runs on one machine in the network and NETCLOCK runs on each workstation. Because these programs communicate through the NetBIOS services of the network, SRVCLOCK can run on any station with a trustworthy clock. When it receives a request from NETCLOCK, SRVCLOCK reads the time from the on-board clock and passes it to the NETCLOCK module. NETCLOCK resets the workstation clock to the value received from SRVCLOCK.

If you are running on non-NetBIOS networks like *NetWare* or *VINES*, don't forget to make NetBIOS services available before using NETCLOCK and SRVCLOCK.

Due to space limitations, we cannot publish the new code for NETCLOCK and SRVCLOCK in this column. However, you can download the new .ASM and .COM files (or the originals) from PC MagNet.

Note: instructions for using PC MagNet are given in the Utilities column of each issue.

Productivity Tip

If you have a DEC VAX in your environment, you should consider using it for a PC network server. DEC, Novell, and Apple all market server software for the VAX. The VAX probably won't be the only server on your LAN, but for big files and heavy printing jobs it works well.

Remote LAN connections are easy using clustered CPU cards

We need to connect remote workstations to Novell-based LANs that are out of state. We will use them for light processing and file transfer, approximately 1 to 3 hours per day. Currently, we add remote workstations for "remote control" through networked PCs running Carbon Copy Plus, fast modems, and voice-grade phone lines. The disadvantages are that we must dedicate network PCs to this job and incur long-distance charges.

Can you tell me what alternatives are available?—William D. Baccich; New Orleans, Louisiana

From what you've written, I don't think using the X.25 services of a public data network (Connectivity Clinic, September 13, 1988) will be economical for you. I suggest you install clustered CPU cards (see "Making Connections: Clustered CPUs," *PC Magazine*, August 1988) in each server. These cards communicate through a modem just like a networked PC, but with much less cost. The QuickLink IV card from Cubix Corp. gives the equivalent of four PCs in one slot.

I think that you should consult with several long-distance telephone carriers. Dialed long-distance calls are more of a bargain today than they ever have been for businesses that have medium-to-large call volumes.

For more information on the QuickLink IV card, write to Cubix Corp., 2800 Lockheed Way, Carson City, NV 89706, or call (702) 883-7611.

Getting back up to speed on connectivity issues

I enjoy the information included in Connectivity Clinic every issue. I have been out of the country and need to get back up to date. Does *PC Magazine* publish this information in any other form or must I buy all possible back issues? Can you recommend other publications that concentrate on telecommunications and connectivity issues?—Mark Nicholson, Glendale, Arizona

You can get the programs listed in this column, plus the full text of the magazine—including back issues—electronically, through PC MagNet on CompuServe.

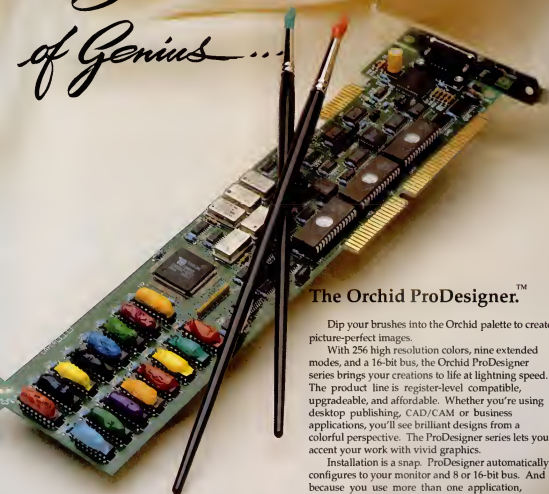
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Mail your contributions to Connectivity Clinic, *PC Magazine*, One Park Avenue, New York, NY 10016, or you may contact Frank J. Derfler, Jr., via MCI Mail (be sure to use Derfler's box named CONNECTIVITY CLINIC).

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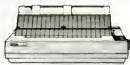
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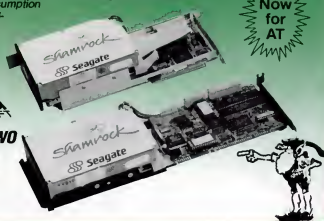
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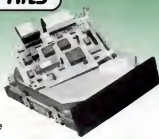


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286¹² Computer

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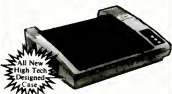
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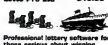
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386 OPERATING SYSTEMS

80386 microprocessors have some exciting capabilities for multitasking, but DOS by itself is unable to tap into most of them. Since it may be some time before a mature OS/2 is prevalent, today's multitasking solutions come from software developers who offer DOS additions, enhancements, and replacements to allow true multitasking on your 386 machine. To turn your computer into several simultaneously functioning PCs, take a look at the evaluations of *Concurrent DOS 386*, *DESQview 386*, *Microsoft Windows 386*, *PC-MOS/386*, and *VM/386*.

FAST AND CHEAP If you've considered purchasing a new 386 machine but thought you'd have to win the lottery to do so, our reviews of six 16-MHz 386s priced under \$3,500 may give you hope.

FILM RECORDERS Slide service bureaux can be an expensive headache. Why not use your creativity, your PC, and some digital technology to produce your own visual material at a fraction of the cost? Film recorders allow you to create vivid 35mm slides of graphics and text output for your presentations.

NEW WAVE ANALYSIS The first PC-based tools for financial analysis were spreadsheets, and they performed the task well. But if you're sick of the rows and wells of formulas and macros you have to write to create and compare "what-if" scenarios, shouldn't you look for a specialized program that automates the process? Financial Feasibilities' \$995 *CFO Advisor* is just that—and it may be pointing the way to the future of PC-based financial analysis. Mike Falkner investigates.

LAN MANAGER ARRIVES *PC Magazine's* LAN Labs examines 3Com's 3+Open LAN Manager, the first network operating system that allows users to connect both DOS- and OS/2-based workstations to OS/2-based servers. Find out why 3+Open LAN Manager poses a real challenge to Novell's *NetWare* in the PC LAN market.



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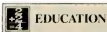
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AFTER HOURS



Computer Study Guide Offers Help in Making The Grade on the SAT

BY STEPHANIE IZAREK

Each year, millions of American teenagers take the SAT college entrance examinations. This year, your child may be one of them. If you want to spare him some of the mental anguish that inevitably accompanies this undertaking, the \$39.95 *Simon & Schuster's Computer Study Guide for the SAT* can help.

The *Computer Study Guide* mimics the actual SAT exam. The program's Exam disk contains two complete tests: each consists of two verbal sections that test basic grammar, vocabulary, reading comprehension, and knowledge of word relations—plus two math sections that test basic geometry, algebra, and quantitative comparisons. The Test of Standard Written English comprises the fifth portion of the exam. All questions are couched in a multiple-choice format.

The program also includes a disk with 500 practice questions to sharpen grammatical and mathematical skills further.

Simon & Schuster publishes

several books to help students prepare for the SAT, but these do not contain the extra features and special functions found in the *Computer Study Guide*. The Practice Question disk comes complete with a calculator and pop-up help screens that offer hints. The Exam disk includes a pop-up scratch pad for making notes, and the software even issues a warning beep to let a student know when the time is almost up.

The most valuable feature is the review section. The software takes a student through the questions in each section and furnishes a complete explanation of why an answer is right or wrong. The *Computer Study Guide* even analyzes the scores and identifies weak areas so that a student can devote extra time to them. This is a feature you just cannot get in a workbook.

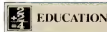
While using the *Computer Study Guide* will not guarantee students a perfect score of 1600, it will help familiarize them with the SAT format. That alone should help relieve some of the anxiety that is part of the SAT experience.

List Price: *Simon & Schuster's Computer Study Guide for the SAT*, \$39.95. **Requires:** 256K RAM, DOS 2.0 or later. *Simon & Schuster Inc.*, Computer Software Division, One Gulf + Western Plaza; New York, NY 10023; (212) 373-8000.

CIRCLE 661 ON READER SERVICE CARD



Science Toolkit's strip chart can graphically record data gathered by any of the sensory probes over a period of time up to 24 hours.



Science Toolkit Lets You Explore the World Of Physics

BY ALAN COHEN

Kitchen tables across America are going to be a whole lot cleaner from now on. That's because *Science Toolkit*, from Broderbund Software, turns any PC into a sophisticated, mess-free home laboratory.

The *Science Toolkit* Master Module provides the budding rocket scientist with all the tools he needs to begin exploring the laws of physics. Two special probes are included: a thermometer to measure temperature and a photocell to measure light intensity. When plugged into the program's interface box (which connects to a game port), these probes control the four on-screen instruments: a thermometer, a light meter, a timer, and a strip chart.

The user guide carefully explains all the experiments, and it includes interesting sidebars that recount important scientific discoveries and facts.

The experiments themselves are not very exciting. There's a limit to the amount of fun one can have watching the tempera-

ture of hot water in a Styrofoam cup gradually drop. Luckily, Module 1: Speed and Motion (sold separately) livens things up. Two on-screen instruments—a speedometer and a tachometer—an additional photocell probe, and a balloon-powered car are included.

As part of an experiment on acceleration, the two photocells, which will be used to control the speedometer, are inserted through slots 6 inches apart in a special cardboard stand. When the front wheels of the Lego-style car pass before the first photocell, they break the beam of light striking the probe and activate the speedometer's timer. When the wheels pass the second photocell, the timer stops and the speedometer calculates the speed of the car.

At \$79.95 for the Master Module and \$39.95 for Module 1, the program may be a bit pricey, but, hey, balloon-powered cars don't come cheap.

List Price: *Science Toolkit*, Master Module, \$79.95; Module 1: Speed and Motion, \$39.95. **Requires:** 128K RAM, CGA or Hercules Graphics Card, DOS 2.0 or later. Game Control Adapter Card required for IBM/Tandy 3000 series and compatibles. No copy protected. Broderbund Software Inc., 17 Paul Dr., San Rafael, CA 94903; (415) 492-3200.

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Simon & Schuster's Computer Study Guide for the SAT mimics the multiple-choice format of the SAT exam.



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CIRCLE 135 ON READER SERVICE CARD

AFTER HOURS

EDUCATION

Changing Your Thought Process for the Better

BY JENNIFER ZAINO

Critical Thinking I, from Compris, challenges you to study and practice something you probably never thought you'd have to—thinking itself.

The software makes use of artificial intelligence; your answers to questions determine the responses you will get. In its simplest form, it means that correct answers are met with praise while incorrect answers are followed by an explanation or a request to explain your response further. Of course, artificial intelligence is not perfect, and it's



Critical Thinking I helps you recognize emotive words that often convey attitudes and prejudices—even when they are disguised as neutral facts.

easy to make a fool of the software by typing in inane answers or gobbledygook.

But for those who are really interested in improving their thinking skills, the program can be of enormous help. You come to understand the way words

can be used to confuse or prey on people's emotions. It helps you recognize Orwellian doublespeak ("an advanced downward adjustment" to describe a cut in social service funding), words that convey attitudes and prejudices as well as facts (one

person's "statesman" is another person's "party hack"), and the vagueness of abstract terms ("democracy" is a style of government claimed by both the Soviet Union and the U.S.).

Critical Thinking shows that you're not just a helpless victim of the way other people manipulate language, either. In fact, the course alerts you to the ways in which you yourself may sometimes be guilty of exploiting language. The software also effectively demonstrates how you can color others' words with your own ideas, and you begin to learn how to separate what someone is actually saying from what you think he is saying. You are also challenged to find the reasons behind the statements people make—an especially helpful exercise in an election year.

Users will have to deal with a rather quirky interface. While

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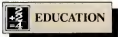
you can type in answers that are more than one line long, words do not elegantly wrap to the next line. You must often type in the word Finish when you have completed a response, a method that seems archaic. You must reboot to exit; when you reenter, you are not at the screen where you left off. On top of that, I was unable to display the graphics portion of the program on two different machines.

At \$275, the software seems fairly high-priced for a single user. The follow-up, *Critical Thinking II*, is only \$25 less. Networked versions for institutions are more reasonable.

Critical Thinking I can improve a conscientious user's thinking skills. But, as the software mentions, there is a danger in this: "Thinking is upsetting—it tells you things you'd rather not know." It's probably a risk everyone should take.

List Price: *Critical Thinking I*, \$275. **Requires:** 256K RAM (512K RAM for color monitor), DOS 2.0 or later. Copy protected. Compeis Inc., 6 Beechwood Ave., Ottawa, Ontario K1L 8B4, Canada; (613) 746-3526.

CIRCLE 963 ON READER SERVICE CARD



A Tool for Tackling Research Assignments

BY MARY KATHLEEN FLYNN

There's probably not a student in existence who has never felt stymied when faced with writing a ten-page term paper in as many days (or—horrors!—hours). Now *Term Paper Writer*,

er, \$52.95 from Activision, offers help by simplifying some daunting research-paper tasks.

The *Notetaker* module imitates index cards. It prompts you for source information and recognizes that different types of sources store information in different ways. If the source is a newspaper article, the *Notetaker* asks you to indicate which section; if it's an encyclopedia, *Notetaker* asks you which volume. Keywords that you determine allow you to search for your notes.

The *Outliner* facility is awkward and limits you to storing only one outline. The *Writer* module is a competent albeit colorless word processor.

Term Paper Writer's most useful feature is the *Footnote* and *Bibliography Compiler*. It compiles the bibliography automatically from the information you've entered in the *Notetaker*.

It writes all entries in the proper form according to the style that you choose (the *MLA Handbook*, for instance).

To create a footnote, just tell the *Writer* where to insert it and which note contains the source information. Numbering and renumbering of footnotes is automatic. If you change a note's source information, the program automatically corrects it in the footnotes and bibliography.

You can format pages with margin, line-spacing, and paper-length choices. Footnotes and bibliography look right, and quotations are indented.

List Price: *Term Paper Writer*, \$52.95. **Requires:** 256K RAM, DOS 2.0 or later. One floppy disk needed for each term paper. Copy protected. Activision, 3885 Bohannon Dr., Menlo Park, CA 94025; (415) 329-0800.

CIRCLE 962 ON READER SERVICE CARD

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CIRCLE 158 ON READER SERVICE CARD

AFTER HOURS



EDUCATION

KidWriter Lets Budding Authors Put Their Imaginations to Work

BY LORI GRUNIN

Too often, educational software for children comes off as didactic, no matter how hard it tries to make learning fun. Spinnaker Software's *KidWriter Golden Edition* teaches writing skills, but it's as much fun as it is educational.

KidWriter, intended for 6- to 10-year-olds, enables children to write their own stories using the built-in word processor and illustrate them with pictures from the program's library.

Your child begins to build a book by selecting one of 17 different backgrounds—anything from the inside of a house to the eruption of a prehistoric volcano. The scenery is changed by simply pointing to the Background icon with a mouse or the cursor keys.

By selecting the Picture icon and dragging their choices onto the background, children can populate these scenes with people, monsters, anthropomorphic flowers, and animals. Pictures can be flipped, but cannot be enlarged or shrunk.

The graphics present plenty

of ways to juxtapose the banal and the bizarre. The rock band looks as much at home on the moon as the astronaut. But if your kid isn't satisfied with the selection of over 200 pictures, *KidWriter* can import "stamps" (cutouts of pictures) from Spinnaker's *Splash!* VGA paint program.

KidWriter provides seven lines for text beneath illustrations and a plain white background for text-only pages.

Your child can add as many pages as he likes by clicking on the Page icon. When he is finished, he can just tell the software to Play and watch it scroll through the story accompanied by a tune. The story can be printed out on most dot matrix monochrome or color printers.

Graphics are the strongest feature, not only because the images are fun to create, but because they are inspirational. They provide a focal point for organizing thoughts: a child who can't think of a story to write might be able to explain how the dinosaur and the mermaid got stranded together on a desert island.

List Price: *KidWriter Golden Edition*, \$49.95. **Requires:** 256K RAM, IBM graphics board, DOS 2.1 or later. Copy protected. Spinnaker Software Corp., One Kendall Sq., Cambridge, MA 02139; (617) 494-1200.

CIRCLE 005 ON READER SERVICE CARD



KidWriter Golden Edition makes your child the author of his own book. He can put people, animals, and other objects into any of 17 different backgrounds, and then write a story to go with them.

The painter was getting very annoyed at the circus people. Now was he supposed to finish painting the big apple with these constant interruptions?



In *Tales from History's "Wagons West"* adventure, various maps of the U.S. frontier will help you make your journey to California or Oregon.



EDUCATION

Tales of Adventure Builds Reading Comprehension Skills

BY ALAN COHEN

It used to be that the best way to improve one's reading skills was to pick up a book and, well... read it. There was a certain progression involved here, from Dr. Seuss, to Frank and Joe Hardy, to Stephen King, to Ernest Hemingway (and for many of us, back to Stephen King again).

But the PC has been intruding on the turf of the printed page—Scholastic Software's *Tales of Reading Adventures* series is a good example. These programs supplement rather than replace the novice reader's Dick and Jane books and tutorials. The programs are not just for children, either—they can also aid adults who want to improve their reading skills.

Tales of Suspense and *Tales from History*, two titles in the series, each contain a pair of graphics-oriented adventures in which you must not only read the story but also make choices that determine the direction that the plot will take. Reaching a successful conclusion requires reading for detail as well as for

comprehension.

Tales of Suspense is made up of "History Mystery," in which the goal is to find a priceless hourglass stolen by the infamous Winsome Slugg, and "The Big Nap," in which one teams up with private eye Rusty Rayburn to unravel the Computer Cowboy kidnapping.

At various points in the tales, decisions will have to be made and questions will have to be answered. All the information you need to make the correct choices and solve the puzzle is right there in the text.

The *Tales from History* adventures also help develop map-reading skills. In each story, to move from point to point, you must make decisions and answer questions based on an on-screen map.

Both of these packages suffer from poor CGA graphics and the absence of a save-game feature. But at \$21.50 each, these witty programs are a good choice for the beginning reader. **List Price:** *Tales of Suspense* and *Tales from History*, \$21.50 each (price includes postage and handling if ordered from Scholastic). **Requires:** 128K RAM, CGA, DOS 2.0 or later. Copy protected. Scholastic Software, P.O. Box 7502, 2931 E. McCarty St., Jefferson City, MO 65102; (800) 541-5513, (800) 392-2179 in Missouri.

CIRCLE 006 ON READER SERVICE CARD

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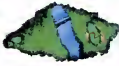
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AFTER HOURS



EDUCATION

Fun with Math: Introducing Your Child to the World of Numbers

BY DONALD B. TRIVETTE

Today's parents are often grooming Junior for Harvard before he graduates from kindergarten. While you may not be quite that pushy, you probably do want your child to begin developing learning skills at an early age and in an unpressured environment. In front of the PC in your home fills the bill. The three programs reviewed here are designed to gently introduce your child to the world of numbers. More important, they show that learning can be fun.

Stickybear Numbers

The \$39.95 *Stickybear Numbers*, part of the Weekly Reader family of educational software,

is a counting and number-recognition program designed for children aged 3 to 6.

Even a very young child soon learns that pressing a number from 0 to 9 causes a corresponding number of objects to appear on the screen, and pressing the Spacebar causes objects to disappear one at a time. Cars and stars, planes and trains, ducks and trucks—and of course, bears—are part of the 250 different picture combinations.

Stickybear has its own operating system, so all your child need do is insert the disk and turn on the PC. Like the other programs reviewed, *Stickybear* uses only CGA graphics, but it makes use of patterns so artfully that the pictures aren't noticeably three-color.

List Price: *Stickybear Numbers*, \$39.95. **Requires:** 128K RAM, CGA. Copy protected. Optimum Resource/Weekly Reader Software, 10 Station Pl., Norfolk, CT 06058; (800) 327-1473, (203) 542-5553.

CIRCLE 060 ON READER SERVICE CARD

Math and Me

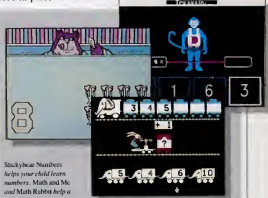
Davidson & Associates' \$39.95 *Math and Me* (also for 3- to 6-year-olds) offers instruction in shape, number, and pattern recognition and simple addition. Each area has three games arranged in order of increasing difficulty.

At the easiest level, a simple but effective method is used to teach the relationship of form to objects. At the most advanced, the child must add two numbers and highlight the correct answer

before hot-air balloons float to the top of the screen—guaranteed to keep any youngster on his toes.

Younger children will require some adult help. Input is by cursor keys, the Esc key, and the Enter key. A mouse may be used in place of the cur-

In his quest to obtain the approval of the dancing Math Rabbit, he'll learn to count, grasp simple concepts about music, do simple addition and subtraction, improve number-matching skills, develop the idea of number series, and test his powers of



Stickybear Numbers helps your child learn numbers. Math and Me and Math Rabbit help a child master addition.

sor/Enter keys to highlight and select answers—an attractive option for young ones.

List Price: *Math and Me*, \$39.95. **Requires:** 256K RAM, CGA, DOS 2.0 or later. Copy protected. Davidson & Associates Inc., 3135 Kashiwa St., Torrance, CA 90505; (213) 534-4070, (800) 556-6141.

CIRCLE 067 ON READER SERVICE CARD

Math Rabbit

The Learning Company's *Math Rabbit*, also priced at \$39.95, is aimed at the 4- to 7-year-old crowd. The program moves beyond the other two by offering customization options that let you alter the speed, numbers, mathematical relationships, and other parameters of games to increase the challenge.

Before you do any customizing, your child will want to work his way through each game's four levels of difficulty.

concentration. (The last few tasks offer a real challenge—even for adults.)

Your child can use the program with a keyboard, but the choice of a joystick rather than a mouse as an optional input device requires him to have some manual dexterity.

All three programs can furnish your child with educationally enriching—and entertaining—experiences. Since the prices are identical and the total is considerably less than a grown-up's spreadsheet or word processor would be, why not treat your kid to all three?

List Price: *Math Rabbit*, \$39.95. **Requires:** 128K RAM, CGA or Hercules Graphics Card, DOS 2.0 or later. Not copy protected. The Learning Company, 6493 Kaiser Dr., Fremont, CA 94555; (800) 852-2255, (415) 792-2101.

CIRCLE 066 ON READER SERVICE CARD

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